9 — System Module

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Baseband description

System module block diagram

The device consists of two different main modules: transceiver (1ax) and UI (1ay). The transceiver board consists of baseband and RF components

The UI board consists of key domes and keypad backlights. Connection between the UI and the transceiver board is established via a board-to-board spring connector.

Note: In this description, user interface HW covers display, camera, keyboard, keyboard backlight and ALS.

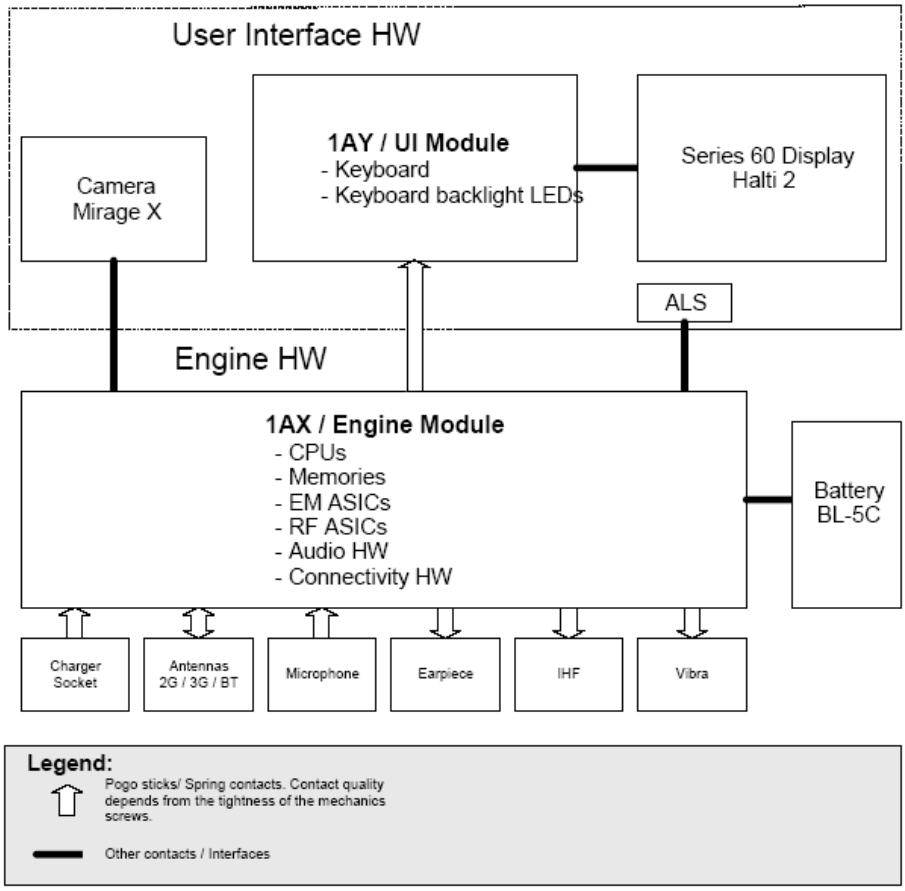

Figure 90 System level block diagram

Baseband functional description

Digital baseband consists of ISA based modem and SYMBIAN based application sections. Modem functionality is in RAP3G and Helen2/3 acts as a platform for SYMBIAN applications.

Modem section consists of RAP3G ASIC with NOR FLASH and SDRAM memory as the core. RAP3G supports cellular protocols of WCDMA (3GPP R-4) and GSM (minimum EDGE glass 10, GPRS phase2). Modem SDRAM memory have 64Mbits of memory and NOR flash have 64Mbits of memory. RAP3G operates with the system clock of 38.4 MHz, which comes from the VCTCXO.

Application section includes Helen3 ASIC with DDR/NAND combo memory as the core. Stacked DDR/NAND application memory has 256Mbits of DDR memory and 256Mbits of flash memory. Helen3 uses 19.2MHz clock, which comes from the RAP3G divided by two from the 38.4 MHz system clock.

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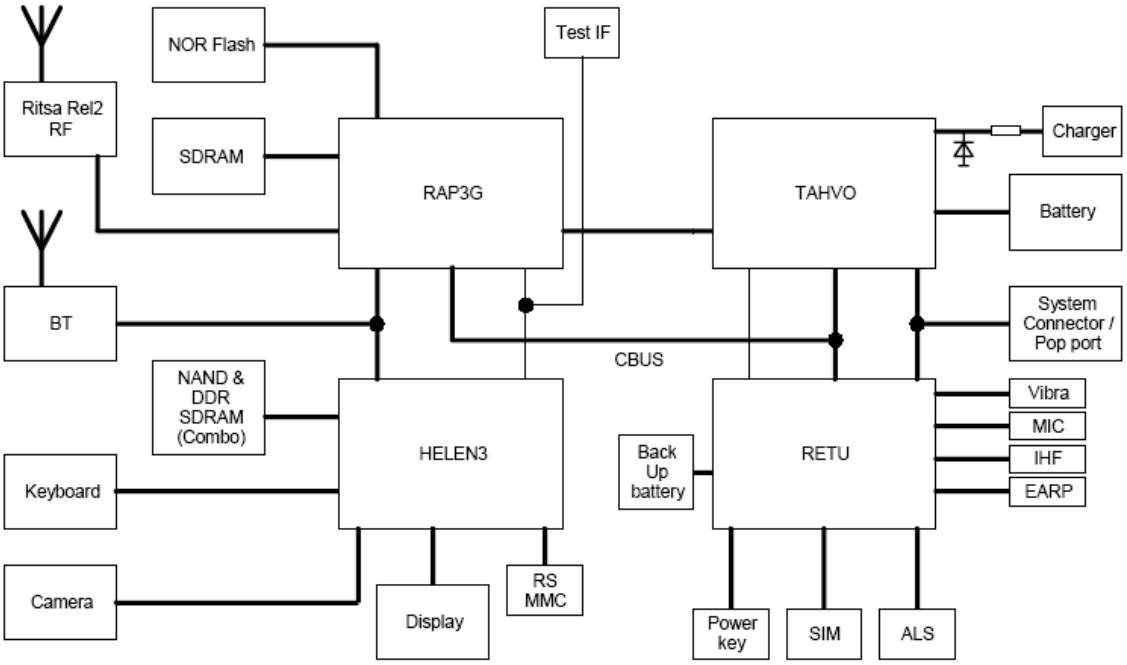

Figure 91 Functional block diagram

Helen3 processor (OMAP1710) is called also as an application ASIC in RM-1 because it is processing application SW and handles the UI SW. It consists of OMAP3.3 and peripheral subsystems like camera-, display- and keyboard driver blocks.

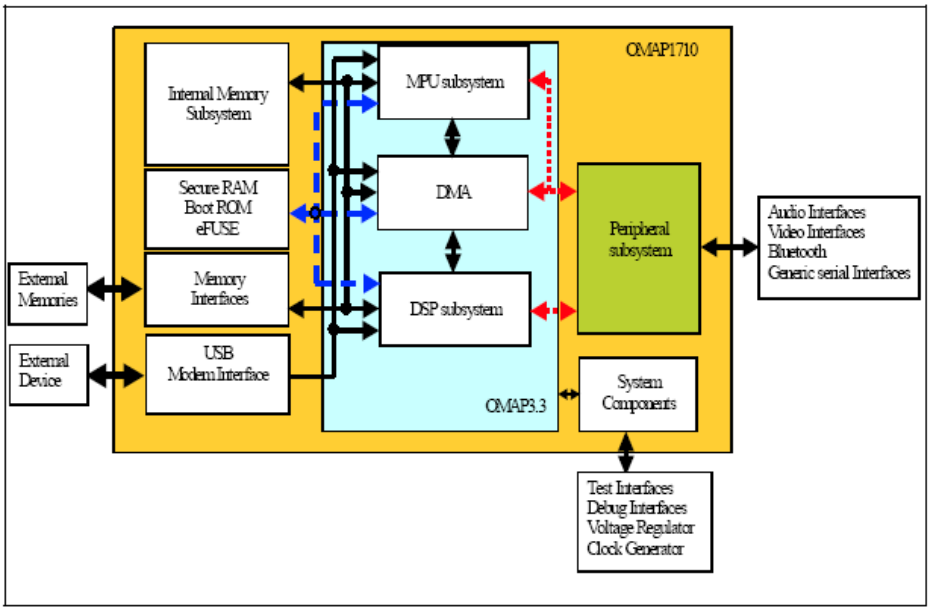

Figure 92 Helen3 high level block diagram

OMAP3.3 consists of ARM926 (MPU subsystem), TMS320C55x (DSP subsystem), DMA and OMAP3.3s internal peripherals.

Helen3s MPU subsystem is based on an ARM926EJ. MPU is able to perform most of the application operations on the chip.

System DMA: This component is mainly used to help the MPU and DSP perform data memory transfer-specific tasks, leaving more available MIPS for both processors.

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The DSP subsystem is based on a TMS320C55x™ DSP core, which is responsible for intensive data computing tasks like real-time audio and video handling on application side. E.g. voice recording.

Internal memory subsystem: This subsystem is composed of a single port SRAM.

Secure modules: OMAP1610 contains a set of several components, including ROM, a single port SRAM, and eFUSE cells. These components enable the system to support secure applications.

Memory interfaces: The memory interfaces define the system memory access organization of OMAP1610.

USB & modem interface: These two modules enable the platform to support a universal serial link and a dedicated modem interface, enabling a high data transfer rate between the modem and the application chip.

System components: System components are group of modules responsible for managing system interactions such as interrupt, clock control and idle.

Peripheral subsystem: The peripheral subsystem defines all the components used to interface OMAP1610 with specific external devices such as camera, keyboard, display etc.

Absolute maximum ratings

Signal	Min	Nom	Max	Unit	Notes
Battery voltage (idle)	-0.3		+4.5	V	Battery voltage maximum value is specified during charging is active
Battery voltage (Call)			+4.3	V	Battery voltage maximum value is specified during charging is active
Charger input voltage	-0.3		+16V	V	
Back-Up supply voltage	0	2.5	2.7	V	Maximum capacity of the backup power supply assumed to be 200 µAh.

Modes of operation

Mode	Description
NO_SUPPLY	(dead) mode means that the main battery is not present or its voltage is too low (below RETU master reset threshold) and that the back-up battery voltage is too low.
BACK_UP	The main battery is not present or its voltage is too low but back-up battery voltage is adequate and the 32kHz oscillator is running (RTC is on).
PWR_OFF	In this mode (warm), the main battery is present and its voltage is over RETU master reset threshold. All regulators are disabled, PurX is on low state, the RTC is on and the oscillator is on. PWR_OFF (cold) mode is almost the same as PWR_OFF (warm), but the RTC and the oscillator are off.
RESET	RESET mode is a synonym for start-up sequence. In this mode certain regulators are enabled and after they and RFClk have stabilized, the system reset (PurX) is released and PWR_ON mode entered. RESET mode uses 32kHz clock to count the REST mode delay (typically 16ms).

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Mode	Description
SLEEP	SLEEP mode is entered only from PWR_ON mode with the aid of SW when the system's activity is low. There are in principle three different sleep modes: • Helen3 sleep • RAP3G sleep • Helen3 and RAP3G sleep (deep sleep) In SLEEP mode RETU's regulators VIO, VDRAM, VSIM1, VSIM2, VAUX and Vana are in low quiescent current mode (output voltages still present but regulators will not give as much current out). Other regulators including VR1 supplying system clock oscillator are disabled. In SLEEP mode, TAHVO VCORE SMPS regulator is in low quiescent current mode (if sleep mode is not internally disabled). Linear regulator VOUT state depends on the accessory connected to the system connector (Pop-Port), if there is any.
FLASHING	FLASHING mode is for SW downloading. FLASHING mode is not really a RETU or TAHVO state but rather a system state. From RETU and TAHVO point of view, it is like PWR_ON. The state is entered from PWR_ON. It is possible to use external voltage (VPP) during flashing to speed up the process (provided that the memory components support the feature).

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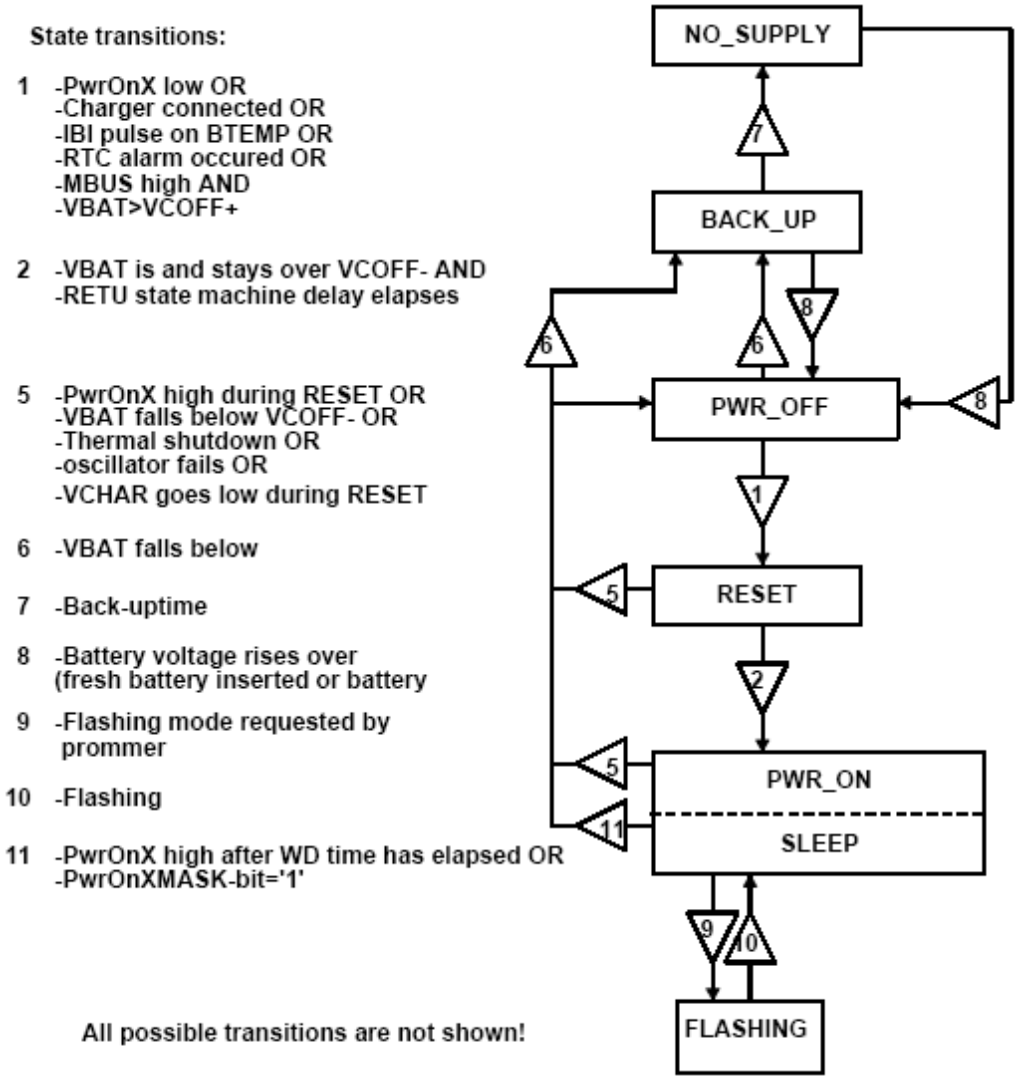

Figure 93 State diagram

Voltage limits

Parameter	Description	Value
VMSTR	Master reset threshold (RETU)	2.2V (typ.)
VMSTR+	Threshold for charging, rising (TAHVO)	2.1V (typ.)
VMSTR-	Threshold for charging, falling (TAHVO)	1.9V (typ.)
VCOFF+	Hardware cutoff (rising)	2.9V (typ.)
VCOFF-	Hardware cutoff (falling)	2.6V (typ.)
SWCOFF	SW cutoff limit	~3.2V

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The master reset threshold controls the internal reset of Retu / (Tahvo). If battery voltage is above VMSTR, UEME's charging control logic is alive. Also, RTC is active and supplied from the main battery. Above VMSTR UEME allows the system to be powered on although this may not succeed due to voltage drops during start up. SW can also consider battery voltage too low for operation and power down the system.

Power key

The system boots up when power key is pressed (adequate battery voltage, VBAT, present).

Power down can be initiated by pressing the power key again (the system is powered down with the aid of SW). Power on key is connected to Retu ASIC via PWRONX signal.

Power distribution

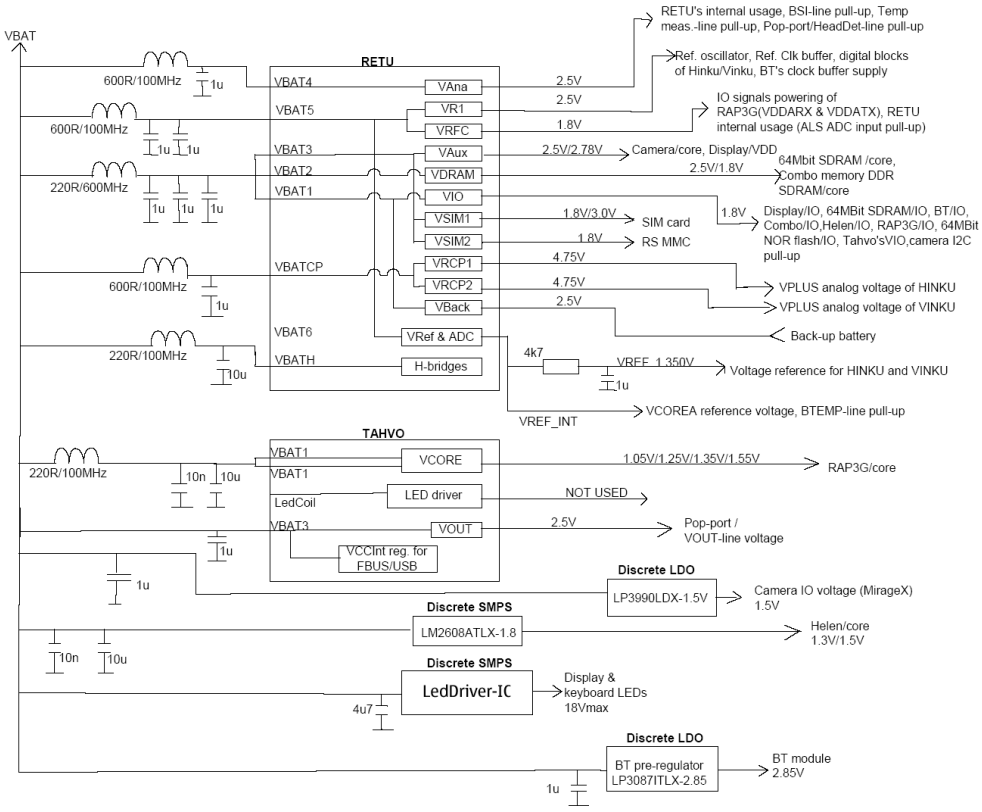

Figure 94 Power distribution diagram

Power supply components:

- RETU
- TAHVO
- Helen VCORE SMPS
- BT
- LDO
- camera LDO
- backlight SMPS

All the above are powered by the main battery voltage.

Battery voltage is also used on the RF side for power amplifiers (GSM PA & WCDMA PA) and for RF ASICs Hinku (Rx) & Vinku(Tx).

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Discrete power supplies are used to generate 2.8V for BT, 1.5V for the camera module, 1.3V/1.5V for Helen3 and 18V for backlight LEDs.

The device supports both 1.8V/3V SIM cards which are powered by RETU / VSIM1. RETUs VSIM2 is used to power RS MMC 1.8V only. USB accessories which needs power from the device are powered by TAHVO / VOUT.

Because LED driver in TAHVO is not used, the external SMPS is used instead. External LED SMPS is still controlled by TAHVO and powered by battery voltage.

System power-up

After inserting the main battery, regulators started by HW are enabled. SW checks, if there is some reason to keep the power on. If not, the system is set to power off state by watchdog. Power up can be caused by the following reasons:

- Power key is pressed
- Charger is connected
- RTC alarm occurs
- MBUS wake-up

After that:

- Retu activates sleep clock and VANA, VDRAM, VIO and VR1 regulators.
- Voltage appearing at Retu's RSTX pin is used for enabling Tahvo ASIC.
- Tahvo enables VCORE regulator and its internal RC-oscillator (600kHz).
- VCTCXO regulator is set ON and RF clock (main system clock) is started to produce.
- Retu will release PURX ~ 16ms after power up is enabled (the RF clock is then stable enough).
- Synchronizing clock (2.4MHz) for Tahvo is started to be produced. After PURX is released and two rising edges of 2.4MHz synchronous clock have been detected in SMPSClk input Tahvo is starting to use that instead of 600kHz internal RC-oscillator.
- HW start-up procedure has been finalized and the system is up and running. Now it is possible for SW to switch ON other needed regulators.

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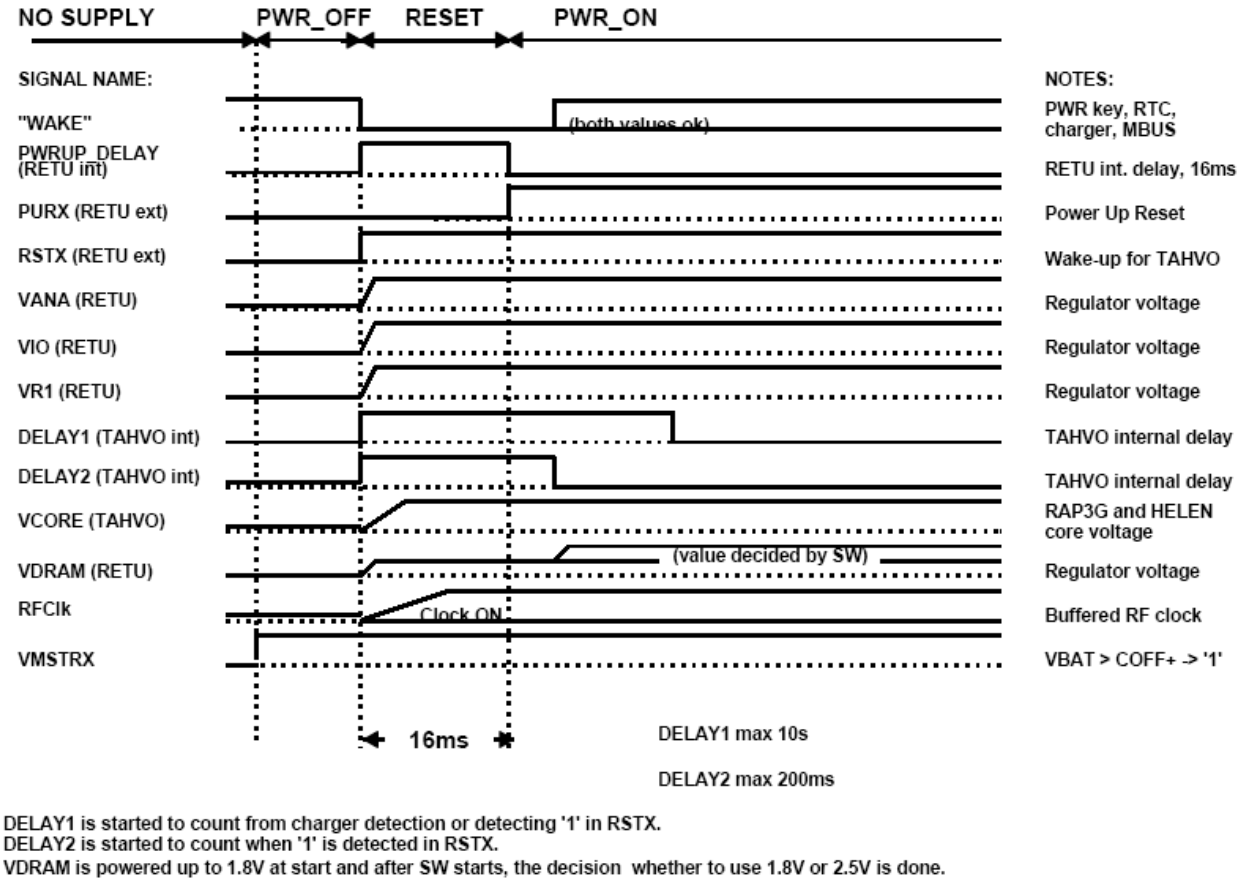

Figure 95 System start-up timing

Clocking scheme

In BB5.0, two main clocks are provided to the system: 38.4MHz RF clock produced by VCTCXO in RF section and 32.768kHz sleep clock produced by RETU with an external crystal.

RF clock is generated only when VCTCXO is powered on by RETU regulator. Regulator itself is activated by SleepX signals from both RAP3G and Helen3. When both CPUs are on sleep, RF clock is stopped.

RF clock is used by RAP3G that then provides (divided) 19.2MHz SysClk further to Helen3. Both RAPG and Helen3 have internal PLLs which then create clock signals for other peripheral devices/interfaces like RS MMC, SIM, CCP, I2C and memories.

32k Sleep Clock is always powered on after startup. Sleep clock is used by RAP3G and Helen3 for low-power operation.

SMPS Clk is 2.4MHz clock line from RAP3G to Tahvo used for switch mode regulator synchronizing in active mode. In deep sleep mode, when VCTCXO is off, this signal is set to '0'-state.

BT Clk is 38.4MHz signal from Hinku ASIC to BT module.

CLK600 is 600KHz signal from Tahvo to APE VCORE SMPS. The clock source is internal RC oscillator in Tahvo (during the RM-1 power-up sequence) or RAP3G SMPS Clk divided by 4 after the power-up sequence.

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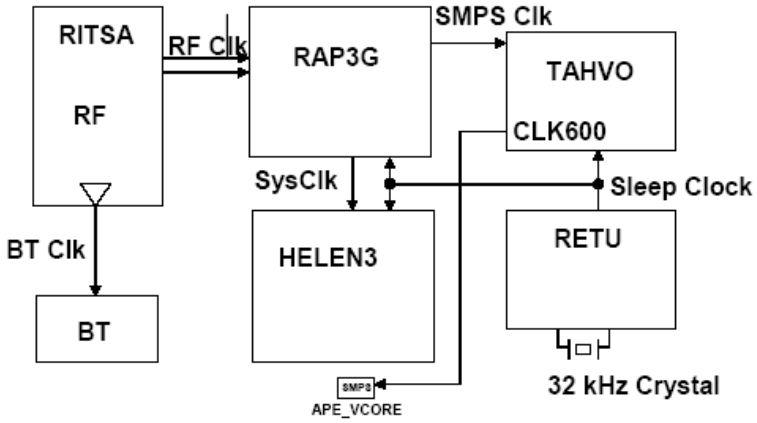

Figure 96 Clocking scheme

Bluetooth

Bluetooth provides a fully digital link for communication between a master unit and one or more slave units. The system provides a radio link that offers a high degree of flexibility to support various applications and product scenarios. Data and control interface for a low power RF module is provided. Data rate is regulated between the master and the slave.

The device Bluetooth is based on CSR's BC3 BT ASIC.

The UART1 interface handles the transfer of control and data information between Helen3 and the BT system (BC3).

The PCM interface is used for audio data transfer between RAP3G and the BT system (BC3).

USB

USB (Universal Serial Bus) provides a wired connectivity between host PC and peripheral devices.

USB is a differential serial bus for USB devices. USB controller (RAP3G) supports USB specification revision 2.0 with full speed USB (12Mbps). The device is connected to the USB host through the Pop-Port™ connector. The USB bus is hot plugged capable, which means that USB devices may be plugged in/out at any time.

See Also

- USB interface electrical characteristics (Page 9–29)

SIM interface

The device has one SIM (Subscriber Identification Module) interface and the SIM card location is under the battery. SIM interface consists of internal interface between RAP3G and Retu and an external interface between Retu and SIM contacts. SIM interface functionality is located in RAP3G while Retu takes care of power up/down, card detection, ATR counting and level shifting. For Retu external SIM IF connections, see SIM interface connections (Page 9–31).

The SIM IF is shown in the following figure:

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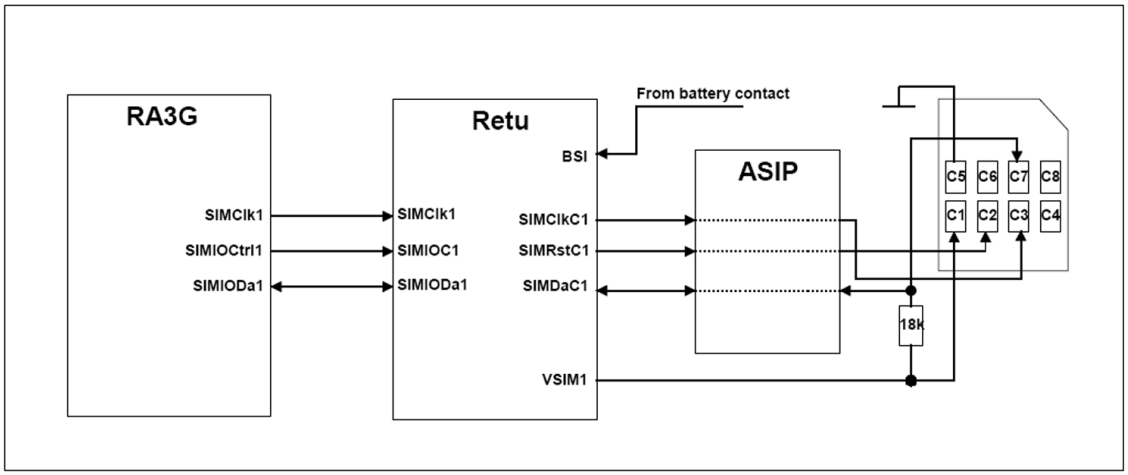

Figure 97 SIM interface

Retu handles SIM card detection and the detection method is based on the BSI line. Due to location of the SIM card removal of the battery causes quick power down of the SIM IF. The Retu SIM1 interface supports both the 1.8V and 3.0V SIM cards. SIM interface voltage is first 1.8V when the SIM card is inserted and if the card does not response to the ATR (Answer To Reset) 3V interface voltage is used. The data communication between the card and the phone is asynchronous half duplex and the clock supplied to cards is 1-5MHz, which is 3.2MHz by default (in GSM system). The data baud rate is SIM card clock frequency divided by 372 (by default), 64, 32 or 16.

RS MMC interface

The reduced size (24mm x 18mm x 1.4mm) multimedia card slot is located under the battery. The device supports RS MMC hot insertion so it is possible to remove/insert the card when the phone is powered on.

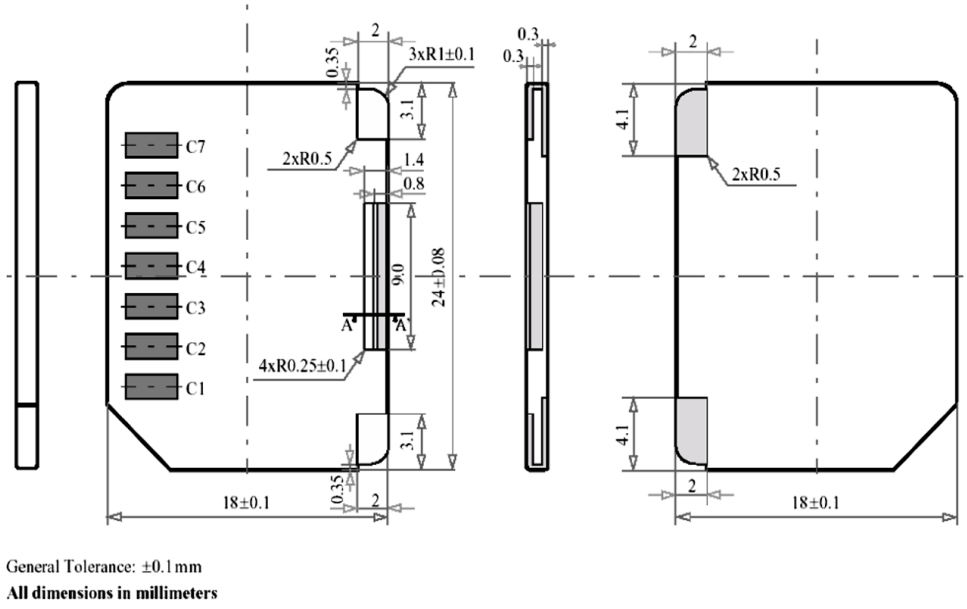

Figure 98 Reduced size MMC

RS MMC card is connected to the Helen3 processor MMC/SDIO2 (1.8V) interface. MMC interface is shown in the following figure:

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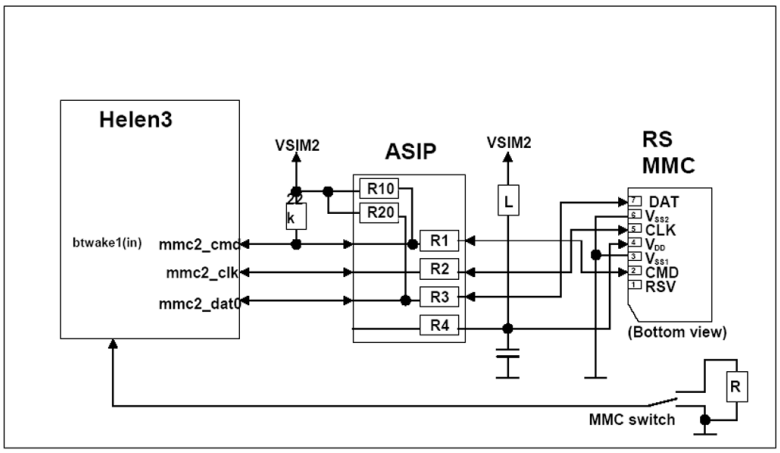

Figure 99 MMC interface

The basic multimedia card concept is based on the following communication signals CLK, CMD and DAT. With each cycle of the CLK signal one bit transfer on the DAT and CMD line is done. The maximum CLK frequency is 20MHz (specified in multimedia card specification). Maximum used CLK frequency at the time is 16MHz. CMD is a bi-directional command channel used for card initialization and data transfer commands. CMD signal has two operational modes open-drain and push-pull mode. Open-drain mode is used for card initialization and push-pull mode for fast command transfer. CMD commands are sent by the host and CMD responses are sent by the card. DAT is a bi-directional data channel, which operates at push-pull mode.

The detection of RS MMC card removal/insertion is done via RS MMC cover switch. Removing RS MMC while writing to RS MMC may corrupt data in RS MMC. RS MMC cover switch gives an interrupt to the SW while the cover is opened or closed. After RS MMC cover lid opening (RS MMC SW signal is connected to GND via cover switch) the SW power down the RS MMC card and switches off the RS MMC power supply (VSIM2). When the RS MMC cover lid is closed (RS MMC SW signal is internally connected in Helen3 to 1.8V) the card should be identified if card exists.

See Also

- RS MMC interface connections (Page 9–31)

Battery interface

The battery interface supports NMP Lynx battery interface for the BL-5C battery. This interface consists of three connectors: VBAT, BSI and GND. BSI line is used to recognize battery capacity by a battery internal pull down resistor.

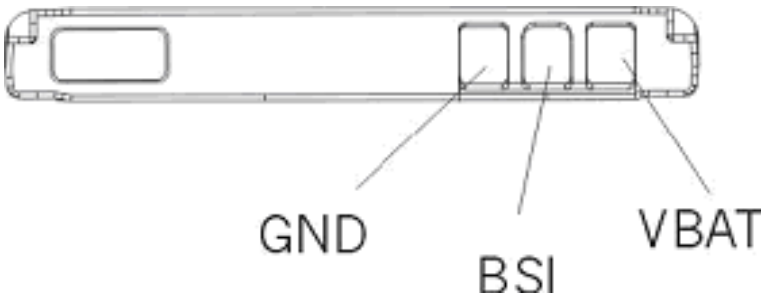

Figure 100 Battery pin order

Battery temperature is estimated by measuring separate battery temperature NTC via BTEMP line, which is located on the transceiver PWB, in a place where phone temperature is most stabile.

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For service purposes the device SW can be forced into local mode by using pull down resistors connected to the BSI line.

See Also

- Battery connector and interface connections & electrical characteristics (Page 9–33)

Camera interface

The device uses a Mirage- X camera module. Mirage-X is a 1.3Mpixel camera with sensor resolution of 1280 x 960. The following figure shows the block diagram where CCP bus is used to transfer image data from camera to engine. Bi-directional control bus is an SW implemented I2C interface.

Camera regulator N1470 powers digital parts of camera. VAUX power rail is for powering analogue parts of the camera.

CAMVCTRL signal (Vctrl) is used for activating the camera module. When Vctrl is turned on High level , the camera module enters the operation mode. When Vctrl is turned on Low level, the camera module enters the power off mode.

CAMCLK signal feeds system clock for camera module.

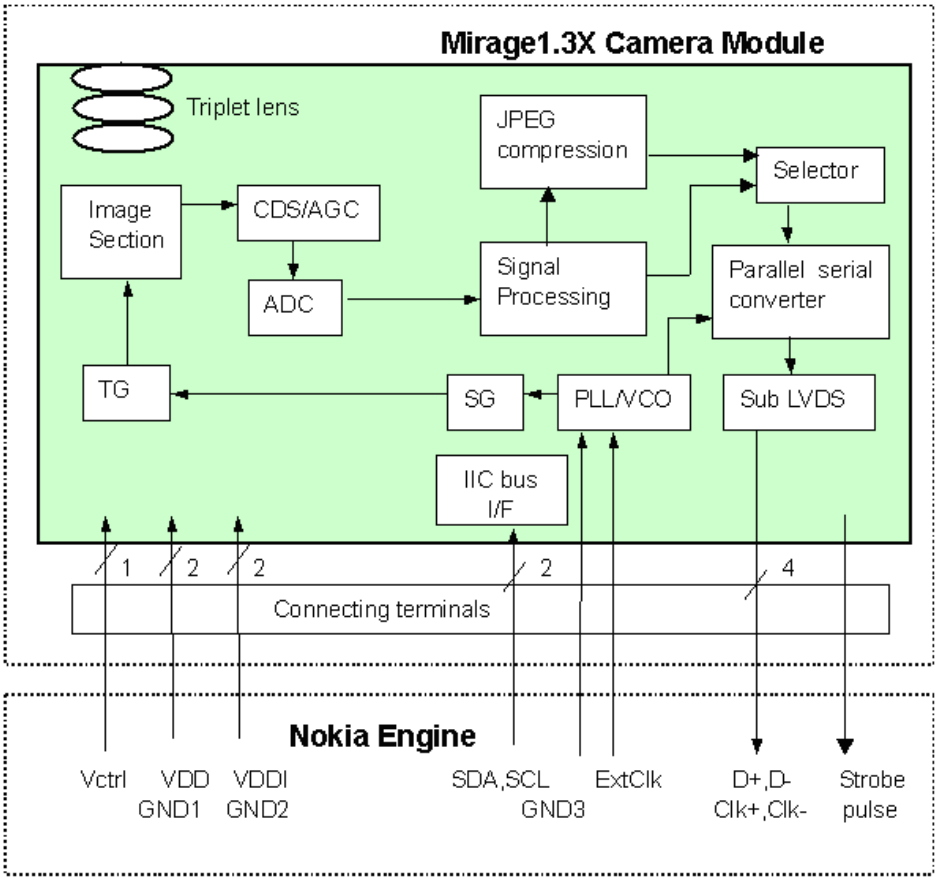

Figure 101 Block diagram of Mirage-X camera module

See Also

- Camera interface connections and electrical characteristics (Page 9–37)

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User interface

Display interface

Display module mechanical concept

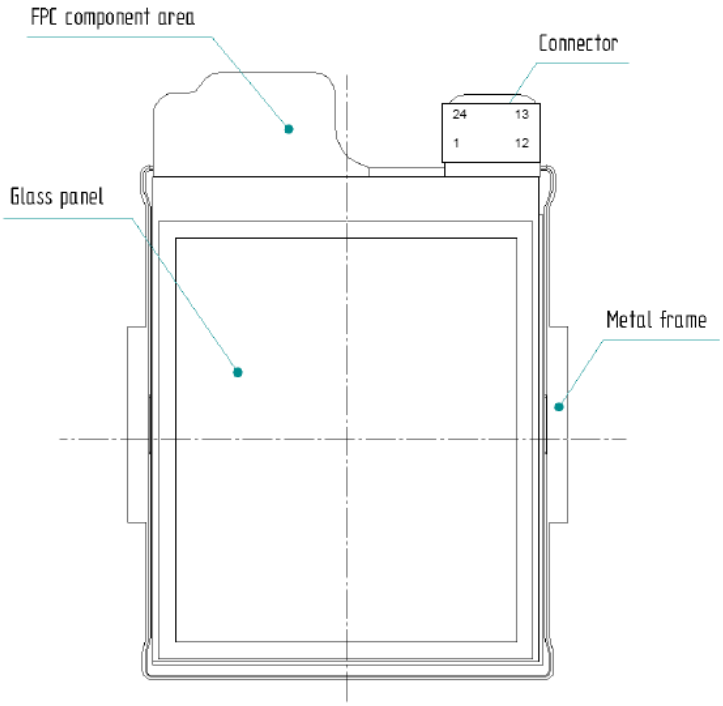

Figure 102 General diagram of the LCD module

Display features:

- 65536 colours
- Partial display function Power saving by pausing display process on part of the screen.
- Built-in RAM capacity 176rows×208lines×16bit = 585,728 bits

The display has two different operating modes:

1 Normal mode, Full screen, 65k colours

2 Normal Partial mode, 65k colors but only part of the display is active

The module includes:

- FPWB foil including connector and discretes and driver circuits
- display panel (glass)
- drivers including display controller and 176 x 208 x 16 bits RAM
- backlight system: lightguide, LEDs and necessary optical sheets
- supporting mechanics
- metal frame (stainless steel)
- plastic frame

The interconnection between the LCD module and the Nokia engine is implemented with a 24-pin board-to-board connector.

Display is controlled via MeSSi-8 interface by Helen3. All MeSSi-8 signals go through the EMC filtering ASIPs.

The display module does not require any tunings in service.

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Keyboard

The device keyboard is connected to the main PWB with a board-to-board connector.

The keymatrix has six rows and four columns. The voice key on the main PWB and the navigation key are connected to the same keymatrix.

Table 7 Keymatrix

	Col3	Col2	Col1	Col0
Row0	Right	Left	Right soft key	Left soft key
Row1	Down	Up	Send	Select
Row2	8	3	2	7
Row3	6	1		5
Row4	#		*	9
Row5	4		Voice	End
Row6	Apps	Clear	Edit	0

Display and keyboard backlight

The device has one Led Driver (SMPS) that is used to drive both display and keyboard LEDs.

Both display LEDs (4pcs) and keyboard LEDs (4pcs) are connected in series.

Current adjustment of the driver is done from the display LED branch, and keyboard current also depends on the display brightness.

In a typical use case, keyboard LEDs are turned ON only in dark ambient lighting conditions.

Control signals for LED driver are:

	From	To	Voltage	Function
GenOut1	TAHVO	R2302 (10k)	0V / 1.8V	Maximum current control (0V ->max curr.)
GenOut2	TAHVO	R2301 (4k7)	0V / 1.8V	
PWM	TAHVO	J2309, N2301	PWM 0%-100%, 1.8V	Current PWM control (16 steps)
GenOut3	TAHVO	V2300	0V / 1.8V	Keyboard LEDs ON (1.8V) /OFF (0V)

ALS interface

Ambient Light Sensor (ALS) is located in the upper part of the phone. It consists of a lightguide (part of front cover), phototransistor (V4400)+ resistor (R4401), NTC + resistors (R4400, R4402, R4403) and RETU EM ASIC (N2200). Information of ambient lighting is used to control backlights of the phone:

- Keypad lighting is switched on only when environment is dark / dim
- Display backlights are dimmed, when environment is dark / dim

Ambient light sensor itself is a photo transistor which is temperature-compensated by an external NTC resistor. Retu with its ADC reads the light sensor (LS) and temperature (LST) results.

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ALS calibration is not possible in the service points. It is replaced by using selected phototransistors as spare parts.

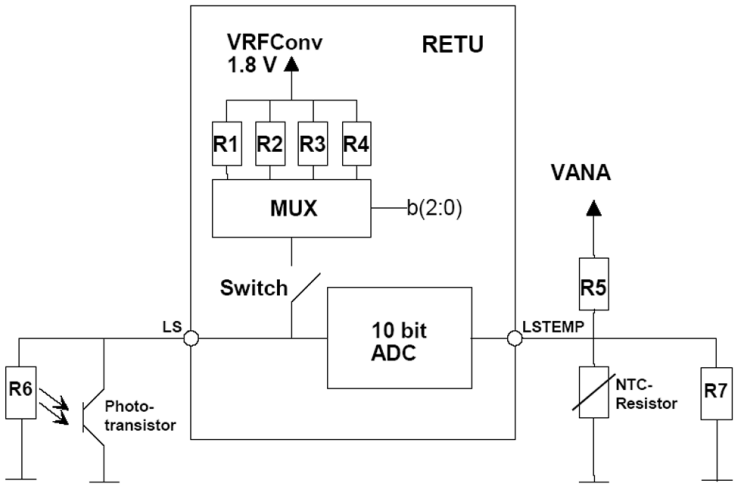

Figure 103 ALS HW implementation

Table 8 ALS resistor values

Symbol	R1	R2	R3	R4	R5	R6	R7	NTC-res
Value	5 kOhm	15 kOhm	30 kOhm	50 kOhm	470 kOhm	100 kohm	470 kohm	47 kOhm

ASICs

RAP3G ASIC

RAP3G ASIC is a 3G Radio Application Processor. RAM memory is integrated into RAP3G.

In general RAP3G consists of three separate parts:

- Processor subsystem (PSS) that includes the main processor and related functions
- MCU peripherals that are mainly controlled by MCU
- DSP peripherals that are mainly controlled by DSP

RAP3G core voltage (1.40V) is generated from Tahvo VCORE and I/O voltage (1.8V) is from Retu VIO. The core voltage in sleep mode is lowered to 1.05V.

Retu EM ASIC

Retu EM ASIC includes the following functional blocks:

- Start up logic and reset control
- Charger detection
- Battery voltage monitoring
- 32.768kHz clock with external crystal
- Real time clock with external backup battery
- SIM card interface
- Stereo audio codecs and amplifiers
- A/D converter
- Regulators

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- Vibra interface
- Digital interface (CBUS)

Tahvo EM ASIC

Tahvo EM ASIC includes the. following functional blocks:

- Core supply generation
- Charge control circuitry
- Level shifter and regulator for USB/FBUS
- Current gauge for battery current measuring
- External LED driver control interface
- Digital interface (CBUS)

Device memories

RAP3G memories NOR flash and SDRAM

Modem memory consists of 64 Mbit SDRAM and 64 Mbit NOR flash memories.

SDRAM is a dynamic memory for ISA SW.

NOR is used for ISA SW code and PMM data and CDSP SW code.

16-bit wide SDRAM interface consists of DDR SDRAM controller from ARM, DCDL/DLLs and wrapper logic. 32-bit wide flash interface is implemented by using EMC module.

SDRAM core voltage (1.8V) is generated from Retu VDRAM and I/O voltage (1.8V) is from VIO. NOR flash uses VIO for both core and I/O voltages.

Combo memory (Helen 3)

The application memory of the device consists of NAND/DDR combo memory. Stacked DDR/NAND application memory has 256 Mbit of DDR memory and 256 Mbit of flash memory. DDR DRAM memory is stacked above the NAND flash.

Helen 3 includes a 16-bit dedicated memory interface called external memory interface fast (EMIFF). This is used to support interface for DDR memory. OMAP1610 provides also NAND flash controller located on the shared peripheral bus, providing support for 8-bit NAND flash. The interface requires an 8-bit address bus multiplexed with 8-bit data bus and several control signals.

Core voltage for DDR is 1.8V, which is generated by discrete LDO (LP3999-1.8). 1.8V (VIO) is for DDR I/O voltage. Both NAND core and I/O voltages are 1.8V generated by VIO.

Audio concept

Audio HW architecture

The functional core of the audio hardware is built around two ASICs: RAP 3G CMT engine ASIC and the mixed-signal ASIC Retu.

Retu provides an interface for the transducers and the accessory connector. Because audio amplifiers are also integrated into Retu, the only discrete electronics components needed for audio paths are audio filtering components and EMC/ESD components.

There are three audio transducers:

- 8mm dynamic earpiece

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- 16mm dynamic speaker
- electret microphone module

In addition to the audio transducers, Retu also provides an output for the dynamic vibra component.

All galvanic audio accessories are connected to the Pop-Port™ accessory connector.

A Bluetooth audio module BC02 that is connected to RAP3G supports Bluetooth audio functionality.

There is a separate application ASIC, Helen 2 (OMAP 1610) for Symbian applications.

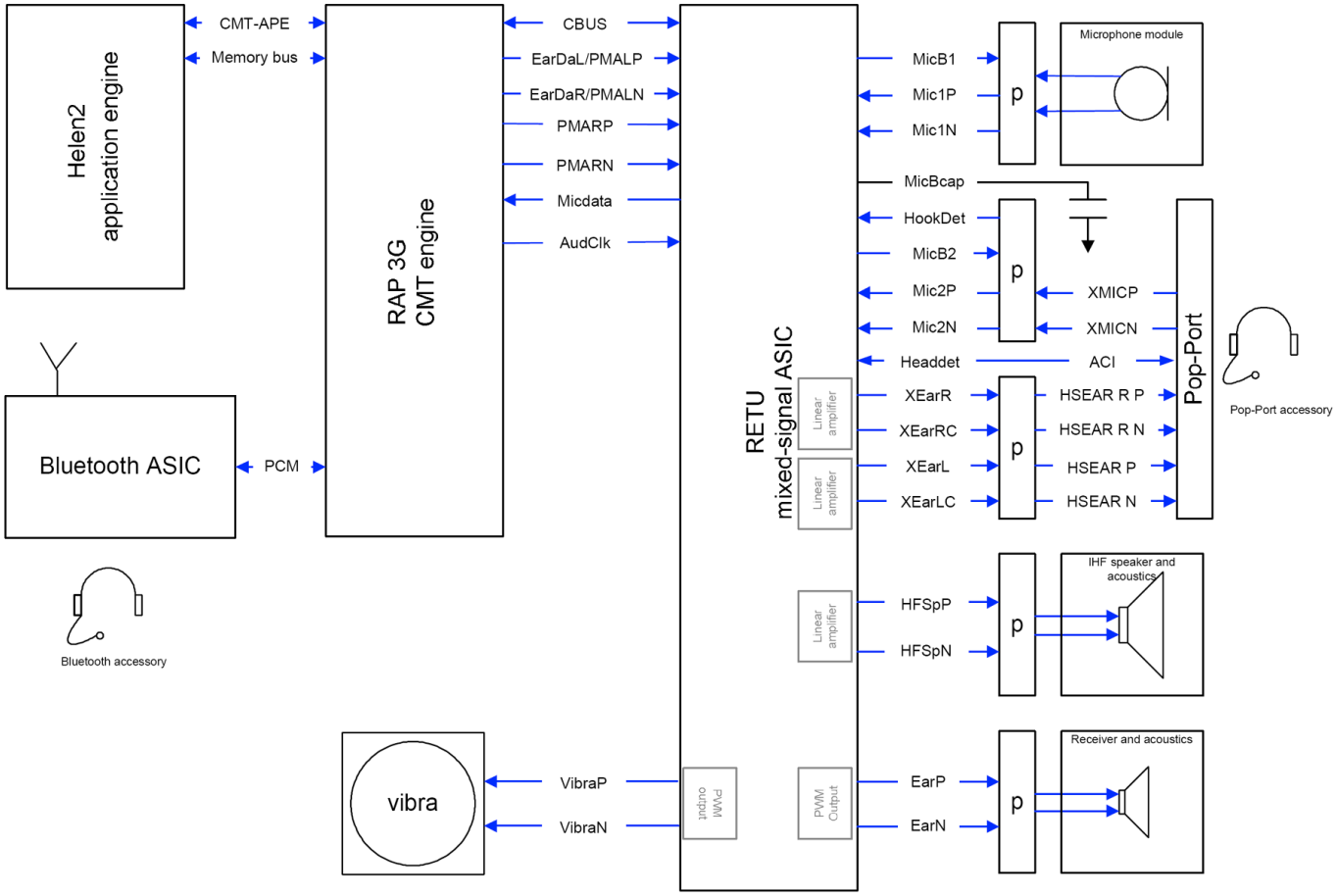

Figure 104 Audio block diagram

Internal microphone

Internal microphone is used for HandPortable (HP) and Internal HandsFree (IHF) call modes.

An analogue electret microphone is connected to Retu ASIC's Mic1P and Mic1N inputs via asymmetric electrical connection.

The microphone is biased by Retu ASIC MicB1 bias voltage output.

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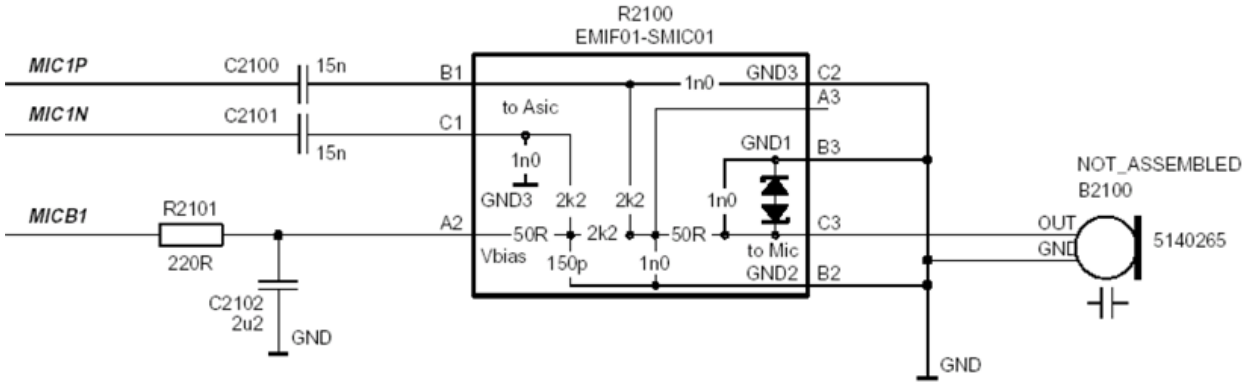

Figure 105 Internal microphone circuitry

External microphone

Galvanic accessories are connected to the system connector (Pop-Port™).

Accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories.

External microphone circuitry is biased by Retu ASIC MicB2 bias voltage output. The circuitry provides a symmetrical connection for the microphone from the Pop-Port™connections, XMICN and XMICP, to Retu ASIC inputs, Mic2P and Mic2N.

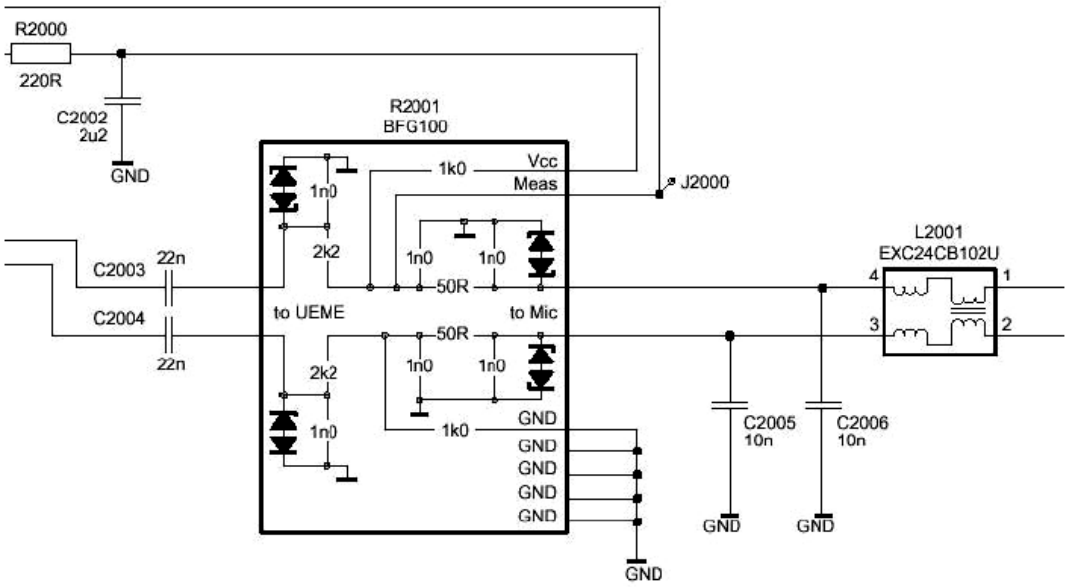

Figure 106 External microphone circuitry (Pop-Port connects to the right side)

Internal earpiece

Internal earpiece is used for the HandPortable (HP) call mode. A dynamic 8mm earpiece capsule is connected to Retu ASIC's differential output EarP and EarN.

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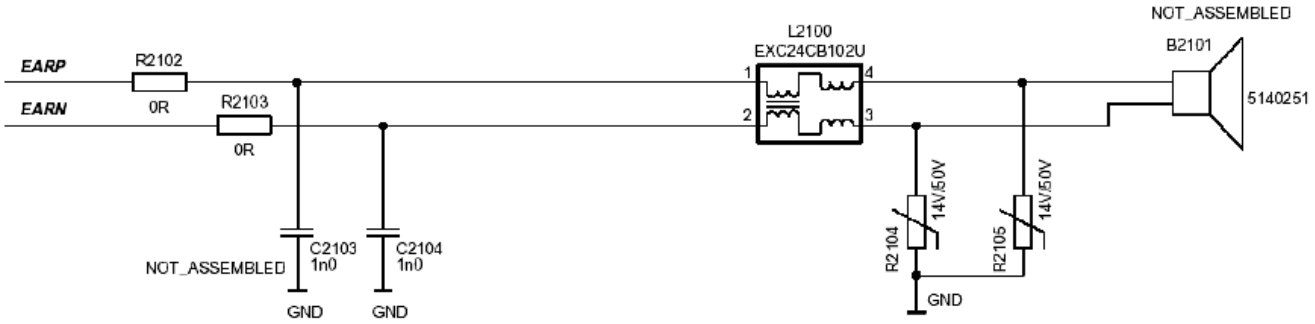

Figure 107 Internal earpiece circuitry

Internal speaker

Internal speaker is used for Internal HandsFree (IHF) call mode.

A dynamic 16mm speaker is connected to Retu ASIC's outputs HFSpP and HFSpN.

IHF amplifier integrated in Retu is a Digital Pulse Modulated Amplifier (DPMA).

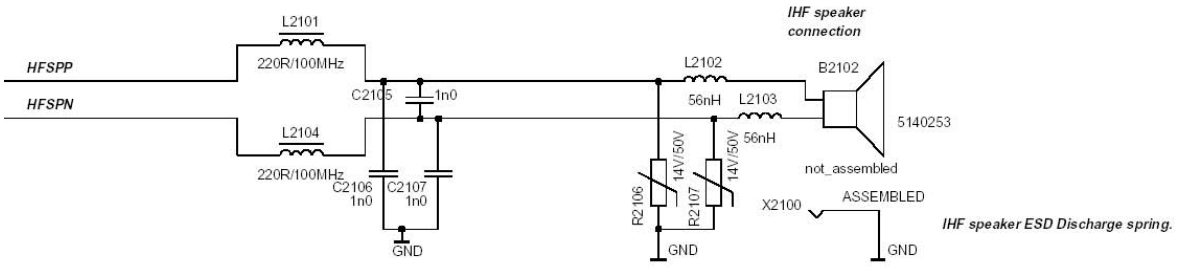

Figure 108 Internal speaker circuitry

External earpiece

Galvanic accessories are connected to the system connector (Pop-Port™).

Accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories.

Retu ASIC provides two output channels in either single-ended or differential format. Retu ASIC outputs XearL and XearLC form the left channel audio output and XearR and XearRC the right channel audio output. XearLC and XearRC are the ground pins if the output works in a single-ended operation.

On the Pop-Port side, HSEAR P and HSEAR N form the left channel output and HSEAR R P and HSEAR R N the right channel output. Respectively, HSEAR N and HSEAR R N are the ground pins if the output works in a single-ended operation.

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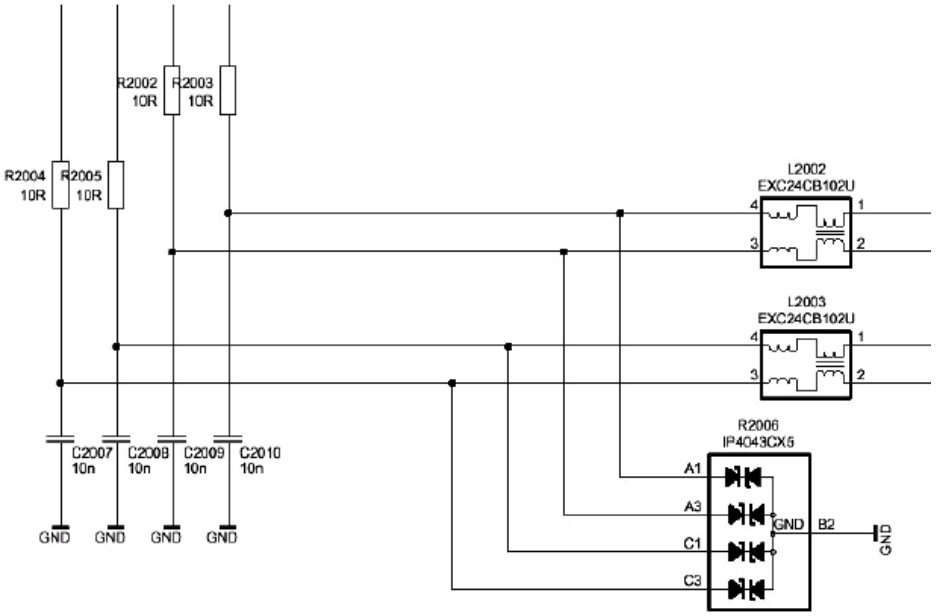

Figure 109 External earpiece circuitry (Pop-Port connected on the right)

Vibra circuitry

Vibra is used for vibra-alarm function.

The vibra motor is connected to the Retu ASIC VibraP and VibraN Pulse Width Modulated (PWM) outputs.

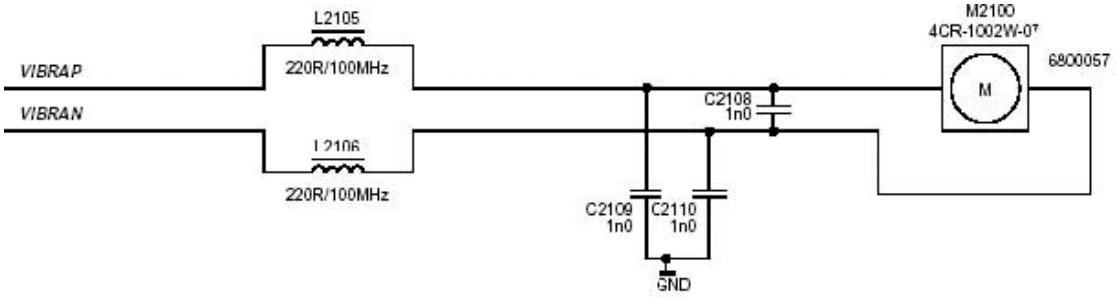

Figure 110 Vibra circuitry

Pop-port™ connector

Pop-Port™ connector provides a fully differential 4–wire connection.

The HandsFree (HF) driver in Retu is meant for the headset.

The output is driven in a fully differential mode. In the fully differential mode, the HF pin is the negative output and the HFCM pin is the positive output. The gain of the handsfree driver in the differential mode is 6 dB.

The earpiece (EARP, EARN) and headset (HF, HFCM) signals are multiplexed so that the outputs cannot be used simultaneously.

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The HF and HFCM amplifiers include a transient suppression circuitry, which prevents undesired spikes in XEarL and XEarLC outputs when switching on and off the amplifiers. The HeadInt line is pulled up to 2.7V by the internal resistor when the accessory is connected. When there is not accessory inserted, the voltage in the HeadInt line will be <0.8 V caused by internal pull down resistor in the HF line.

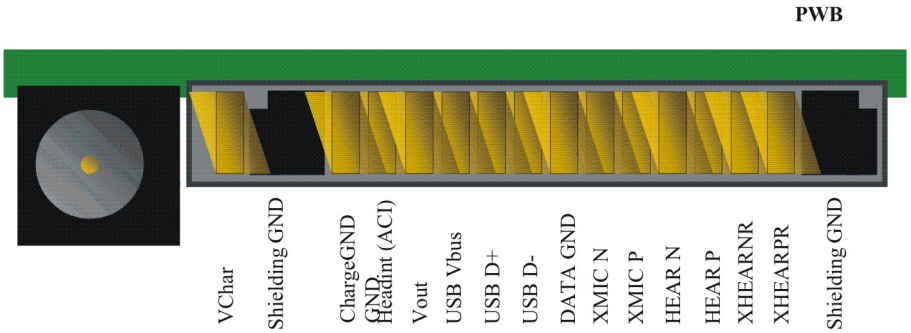

Figure 111 External audio connector

Table 9 Audio connector pin assignments

Pin #/ Signal name	Signal description	Spectral range	Voltage/ Current levels	Max or nominal serial impedance	Notes
1/ Charge	V Charge	DC	0-9V/ 0.85A		
2/ GND	Charge GND	-	0.85A	100mW (PWB+ conn.)	
3/ ACI	ACI	1kbits/s	Digital 0 / 2.5-2.78V	47W	Insertion & removal detection
4/ Vout	DC out	DC	2.78V 70 mA / 2.5V 90mA	100mW (PWB+ conn.)	200mW
9 / XMIC N	Audio in	300-8k	1Vpp & 2.5-2.78VDC		
10 / XMIC P	Audio in	300-8k	1Vpp & 2.5-2.78VDC		
11 / HEAR N	Audio out	20-20k	1Vpp	10W	
12 / HEAR P	Audio out	20-20k	1Vpp	10W	
13 / HEAR R N	Audio out	20-20k	1Vpp	10W	Not conn. in mono
14 / HEAR R P	Audio out	20-20k	1Vpp	10W	Not conn. in mono

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Baseband technical specifications

External interfaces

Name of Connection	Connector reference	Material Code
USB	X2001	5460061
Charger	X2000	5400243
Headset	X2001	5460061
SIM	X2700	N/A
RS MMC	X5200	5469301
Battery connector	X2070	5409255

ACI interface electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
Accessory detection						
Headset detection threshold		1.75	1.9	2.05	V	Retu specific
Headset detection hysteresis			25		mV	
Headset detection pull ups		1	2	4	uA	
After Mbus is switched to HeadDet						
High-level input voltage (VDDS = 1.8V)	V_{IH}	0.7 x V_{DDS}		V_{DDS}	V	RAP3G specific
Low-level input voltage	V_{IL}	0		0.3 x V_{DDS}	V	
High-level output voltage	V_{OH}	0.8 x V_{DDS}		V_{DDS}	V	
Low-level output voltage	V_{OL}	0		0.22 x VDDS	V	
Rise/fall time	tR/tF			25	ns	

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VOUT electrical characteristics

Description	Parameter	Min	Max	Unit	Notes
Vout regulator for external accessories	VOUT	2.43	2.57	V	Max load 90mA

USB IF electrical characteristics

Description	Parameter	Min	Max	Unit	Notes
Absolute maximum voltage on D+ and D-	$V_{D+/D-}$	-1	4.6	V	USB specification revision 2.0
Supply voltage	VBUS	4.4	5.25	V	
Supply current:					
Functioning	I_{VBUS}		100	mA	
Suspended	I_{VBUS}		500	uA	
Unconfigured	I_{VBUS}		100	mA	
High-level input voltage:				V	
High (driven)	V_{IH}	2			
High (floating)	V_{IHZ}	2.7	3.6		
Low-level input voltage	V_{IL}		0.8	V	
Differential input sensitivity	V_{DI}	0.2		V	|(D+) - (D-)|
Differential input voltage range	V_{CM}	0.8	2.5	V	Included VDI range
Low-level output voltage	V_{OL}	0	0.3	V	
High-level output voltage (driven)	V_{OH}	2.8	3.6	V	
Output signal crossover voltage	V_{CRS}	1.3	2	V	

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FBUS interface electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
High-level input voltage (VDDSHV2 = 1.8V)	V_{IH}	0.7 x V_{DDSHV2}		V_{DDSHV2}	V	Helen2/3 specific
Low-level Input voltage	V_{IL}	0		0.3 x V_{DDSHV2}	V	
High-level output voltage	V_{OH}	0.8 x V_{DDSHV2}		V_{DDSHV2}	V	
Low-level output voltage	V_{OL}	0		0.22 x V_{DDSHV2}	V	
Rise/fall time	tR/tF	0		25	ns	

Headset hook detection interface (XMICN) electrical characteristics

Description	Min	Typ	Max	Unit	Notes
Hook detection threshold 1	1.25	1.35	1.45	V	Two fixed thresholds inside Retu. Selectable by SW
Hook detection threshold 2	0.5	0.6	0.7	V	
Hook detection hysteresis		25		mV	
Hook detection pull ups	1	2	4	uA	

Audio signal electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
XMIC N	Audio in		1		V_{pp}	DC Offset 2.5-2.78V
XMIC P	Audio in		1		V_{pp}	DC Offset 2.5-2.78V
HSEAR N	Audio out		1		V_{pp}	10Ω nominal serial impedance

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Description	Parameter	Min	Typ	Max	Unit	Notes
HSEAR P	Audio out		1		V_{pp}	10Ω nominal serial impedance
HSEAR R N	Audio out		1		V_{pp}	10Ω nominal serial impedance
						Not connected in mono
HSEAR R P	Audio out		1		V_{pp}	10Ω nominal serial impedance
						Not connected in mono

SIM IF connections

Pin	Signal	I/O	Engine connection		Notes
C1	VSIM	Out	Retu	VSIM1	Supply voltage to SIM card, 1.8V or 3.0V.
C2	SIMRST	Out	Retu	SIM1Rst	Reset signal to SIM card
C3	SIMCLK	Out	Retu	SIM1ClkC	Clock signal to SIM card
C5	GND	-	GND		Ground
C7	SIMDATA	In/Out	Retu	SIM1DaC	Data input / output

RS MMC interface connections

Pin	Signal	I/O	Engine connection		Notes
1	RSV		NC	NC	Reserved for future use
2	CMD	<->	Helen2/3	MMC2_CMD	Command/ Response
3	Vss1		GND		Ground
4	V_{DD}	<-	Retu	VSIM2	VSIM2, supply voltage 1.8 (Max 70mA)

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Pin	Signal	I/O	Engine connection		Notes
5	CLK	<-	Helen2/3	MMC2_CLK	External clock for the MMC card, Max 20 MHz
6	Vss2		GND		Ground
7	DAT	<->	Helen2/3	MMC2_DAT0	Bi-directional data bus
-	MMCDET	->	Helen2/3	btwake1(in) [P10]	MMC card detect

Charger connector and charging interface connections & electrical characteristics

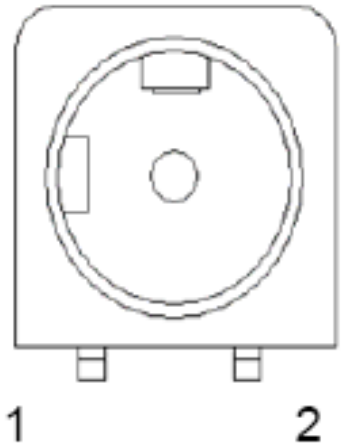

Figure 112 Charger connector

Table 10 Charging interface connections

Pin	Signal	I/O	Engine connection		Notes
1	Vchar	In	Tahvo	VCharIn1, 2	Charging voltage / charger detection, Center pin
2	Charge GND		Ground		Charger ground

Table 11 Charging IF electrical characteristics

Description	Parameter	Min	Max	Unit	Notes
Vchar	V Charge	0	9	V	Center pin
Vchar	I Charge		0.85	A	Center pin
Charge GND			0.85	A	

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Description	Parameter	Min	Max	Unit	Notes
Threshold for charging, rising (TAHVO)	V_{MSTR+}	2.1		V	Typical value
Threshold for charging, falling (TAHVO)	V_{MSTR-}	1.9		V	Typical value

Battery connector and interface connections & electrical characteristics

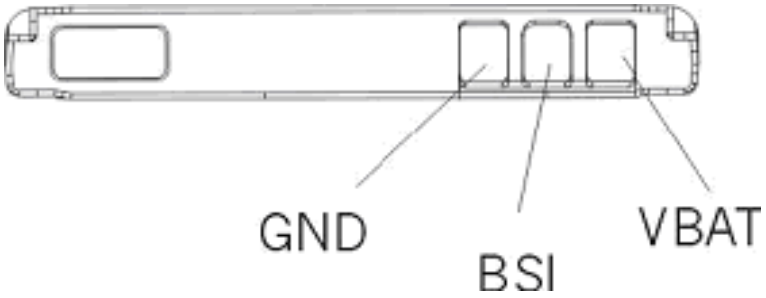

Figure 113 Battery connector

Table 12 Battery interface connections

Pin	Signal	I/O	Engine connection		Notes
1	VBAT	->	Retu	VBAT	Battery voltage
2	BSI	->	Retu	BSI	Battery size indication (fixed resistor inside the battery pack)
3	GND		GND		Ground

Table 13 Battery IF electrical characteristics

Description	Parameter	Max	Unit	Notes
Operation voltage	V_{IN}	4.23	VDC	
Current rating	I_{IN}	0.9	A	

Internal interfaces

Name of Connection	Connector reference	Material Code	Notes
UI connector	X4400	5469983	
Display	X4401	5469219	
Camera	X1470	5409297	Mirage 1.3X

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Name of Connection	Connector reference	Material Code	Notes
ALS	V4400	486B033	Ambient Light Sensor
Vibra	M2100	6800057	
Microphone	B2100	5140265	
Earpiece	B2101	5140251	
IHF speaker	B2102	5140253	

UI module connector and IF connections

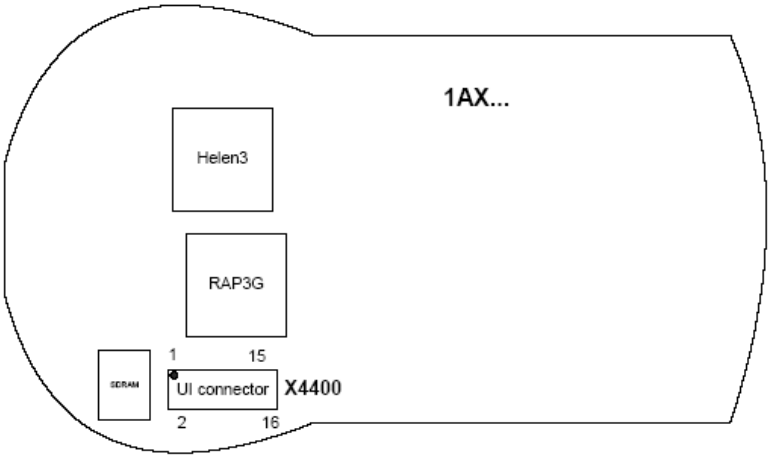

Figure 114 UI connector

Table 14 User interface connections

Pin	Signal	I/O	Engine connection		Notes
1	GND		GND		
2	LED+	<-	N2301	VLEDOUT2	Discrete Backlight SMPS (controlled by Tahvo)
3	Col2	->	Helen3	Kbc_2	
4	LED-	->	R2305 + V2300	SETCURR2	Serial resistor + Transistor switch (controlled by Tahvo)
5	Col1	->	Helen3	Kbc_1	Voice switch connection
6	GND		GND		
7	Row3	->	Helen3	Kbr_3	
8	Row2	->	Helen3	Kbr_2	

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Pin	Signal	I/O	Engine connection		Notes
9	Row1	->	Helen3	Kbr_1	
10	Row6	->	Helen3	Kbr_6	
11	Row0	->	Helen3	Kbr_0	
12	Col0	->	Helen3	Kbc_0	
13	Row5	->	Helen3	Kbr_5	Voice switch connection
14	Row4	->	Helen3	Kbr_4	
15	GND		GND		
16	Col3	->	Helen3	Kbc_3	

Keyboard interface electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
High-level input voltage (VDDS = 1.8V)	V_{IH}	0.65* V_{DDS}	V_{DDS}	0.3+ V_{DDS}	V	Row
Low-level input voltage	V_{IL}	-0.3	0	0.35* V_{DDS}	V	Row
High-level output voltage	V_{OH}	1.62	V_{DDS}	1.98	V	Column
Low-level output voltage	V_{OL}		0	0.45	V	Column

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Display connector and interface connections

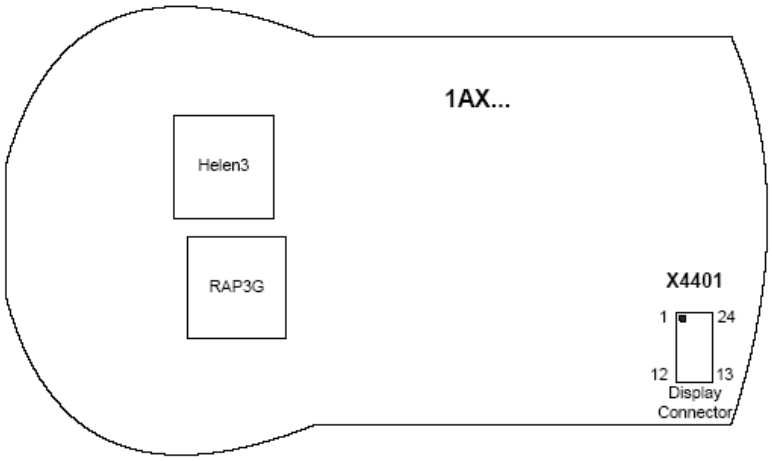

Figure 115 Display connector

Table 15 Display interface connections

Pin	Signal	I/O	Engine connection		Notes
1	GND				
2	WRX	->	Helen3	Lcdwrx	Write Enable (active low)
3	GND				
4	D0	<->	Helen3	Lcdda0	Data
5	D1	<->	Helen3	Lcdda1	Data
6	D2	<->	Helen3	Lcdda2	Data
7	D3	<->	Helen3	Lcdda3	Data
8	GND				
9	VDDI	<-	Retu	VIO	Interface voltage
10	VDD	<-	Retu	VAUX	Core voltage
11	GND				
12	LEDin	<-	N2301	VLEDOUT1	N2301 is controlled by Tahvo
13	LEDout	->	R2304	SETCURR1	Sink resistor
14	GND				
15	CSX	<-	Helen3	Lcdcsx	Chip Select (active low)

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Pin	Signal	I/O	Engine connection		Notes
16	D/CX	<-	Helen3	Lcdcmd	Data/ Command select (high=data, low =command)
17	GND				
18	D7	<->	Helen3	Lcdda7	Data
19	D6	<->	Helen3	Lcdda6	Data
20	D5	<->	Helen3	Lcdda5	Data
21	D4	<->	Helen3	Lcdda4	Data
22	TE	->	Helen3	Te	Tearing Effect
23	RDX	<-	Helen3	Lcdrdx	Read Enable (active low)
24	RESX	<-	Helen3	Gpio_60	Reset (active low)

Camera interface connections and electrical characteristics

Table 16 Camera interface connections

Pin	Signal	I/O	Engine connection		Notes
1	GND1				Ground line corresponding to VDD
2	SDA	<->	Helen3	sda	I2C serial control bus data
3	D+	->	Helen3	Ccpdap	Differential serial data, positive node
4	SCL	<-	Helen3	scl	I2C serial control bus clock
5	D-	->	Helen3	Ccpdan	Differential serial data, negative node
6	CAMCLK	<-	Helen3	ExtClk	System clock for camera module
7	VDDI	<-	Regulator	VCAM	Camera Digital Voltage

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Pin	Signal	I/O	Engine connection		Notes
8	GND3				Ground line corresponding to ExtClk
9	CLK+	->	Helen3	Ccpclkp	Differential serial clock, positive node
10	CAMVCTRL	<-	Helen3	VCtrl	Camera module activating signal
11	CLK-	->	Helen3	Ccpclkn	Differential serial clock, negative node
12	VDD	<-	Retu	VAUX	Camera Analog Voltage
13	Strobe	->	R2013 / R2014	Cam_strobe	Strobe timing pulse
14	GND2				Ground line corresponding to VDDI

Table 17 Camera CCP IF electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
Common mode voltage	VCMF	0.8	0.9	1	V	-1
Differential voltage swing	VOD	100	150	250	mV	-2
Operating frequency	fCLK	1		175	MHz	SW controls frequency
Differential rise and fall time		300		800	ps	-3

Note:

- Common mode voltage is a mean value of high and low states of one single-ended signal.
- Differential voltage swing is differential amplitude between signals of differential pair.
- Differential transitions should be only measured with good equipment (bandwith > 1GHz), otherwise results will seem too slow.

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Table 18 Camera supply voltage characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
Camera analog voltage	VDD	2.37	2.5	2.63	V	
Camera digital voltage	VDDI	1.4	1.5	1.65V	V	

Table 19 Camera control IF electrical characteristics

Description	Parameter	Min	Typ.	Max	Unit	Notes
SDA, SCL, Vctrl, ExtClk	VIH	1.5	1.8	VDD	V	High-level input voltage
SDA, SCL, Vctrl, ExtClk	VIL	0	-	0.54	V	Low-level input voltage
SDA	VOL	0	-	0.4	V	High-level output voltage
Regulator Enable	VOH	1.35	1.8	2.3V	V	Helen3 GPIO High-level output voltage
Cam_strobe	VOH	0.8 x VDD	-	VDD		High-level output voltage
Cam_strobe	VOL	0	-	0.4	V	Low-level output voltage
ExtClk	fExtClk		9.6		MHz	SW controls frequency
SDA, SCL	tR			300	ns	Risetime

Back-up battery interface connections and electrical characteristics

Table 20 Back-Up battery connections

Pin name	I/O	Connection	Notes
L2207, VBack	->	Retu, VBack	Back-up battery G2200 is connected to RETU via coil

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Table 21 Back-Up battery electrical characteristics

Description	Parameter	Min	Typ	Max	Unit
Back-Up Battery Voltage	Vback	0	2.5	2.7	V

RF description

Introduction to receiver functionality

Receiver functions are implemented in RF ASIC N7501.

The receiver is a linear direct conversion receiver consisting of separate front ends (LNA and demodulator) for each supported system.

After the demodulators, the signal paths are combined to one common BB path.

WCDMA receiver

In the WCDMA mode, the received signal is fed from the antenna to the duplex filter. After the duplex filter the signal goes via balun to the integrated LNA residing in N7501. After the LNA, the signal goes trough an off chip band pass SAW filter. The main task of the filter is to attenuate the Tx signal which is leaking trough the duplex filter and amplified by LNA.

After filtering, the signal goes to the down conversion mixer, which converts the signal into baseband I and Q signals (90 degrees phase shift). After the demodulator output there is a RC low pass filter with f0 of ca. 1.5 MHz. It is effectively part of the BB selectivity filtering.

At BB frequency the signal is amplified and fed to a low pass filter giving the selectivity of the receiver. The filters need RC constants, which suffer of process variations. Therefore the integrated resistors are adjustable by digital control word.

Rx channel filter must be calibrated with automatic routine whenever N7501 IC is changed to a phone.

In the WCDMA mode, the corner frequency of the filter is set to ca. 2.1MHz. The filter is followed by an AGC amplifier with adjustable gain. Signal is further amplified before it is fed to balanced analogue IQ output pins. Analogue output pins are accompanied by reference voltage output, which sets the DC level for the AD converter in BB ASIC RAP3G.

The gain of the Rx chain can be adjusted in multiple phases. The first adjustable gain is in LNA which has low, mid and high gain settings and isolation mode. After the mixer, there are adjustable gains (AGC) inside the N7501 IC.

The last stage of the RF Rx chain is an output buffer which feeds the signal and a reference voltage (VREFCM) to BB ASIC. The AGC stages are used to maintain the voltage swing at the input of the AD converters at an adequate level.

The gain of the Rx chain is measured in production at one RF frequency and power level, so that RSSI reporting gets calibrated. If N7501IC is changed this calibration needs to be performed.

GSM receiver

As GSM900, GSM1800 and GSM1900 Rx branches are functionally identical, the following description is applicable to all of them.

The received signal goes from the GSM antenna to the antenna switch module. The switch module contains PIN diode switches for a band and Rx/Tx selection and also Rx SAW filters.

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The antenna switch module is followed by integrated LNAs residing in N7501.

The LNAs are followed by demodulators which downconvert the signal to baseband I and Q signals.

After the down conversion mixer, the Rx chain is similar to WCDMA Rx. Channel select filter is set to 115 kHz in the GSM mode.

In the GSM mode, the DC compensation is carried out before the reception slot.

During an operation called DCN1 a sample of the DC level of the signal is stored in sufficiently large off chip capacitors. During reception, information is in turn used for subtracting the DC information from the input signal of the AGC amplifier.

DCN0 operation is carried out to discharge any charge from the capacitors before DCN1. This guarantees that the starting point for the DC compensation is always the same.

See Also

- WCDMA receiver (Page 9–40)

Introduction to transmitter functionality

Transmitter functions are implemented in the RF ASIC N7501. It contains a BB frequency low pass filter, which is tunable according to the signal bandwidth of the system in use.

In addition, N7501 contains three separate RF paths (GSM900, GSM1800/1900 and WCDMA) comprising a final frequency IQ modulator and VGA amplifiers.

In order to eliminate the effect of process variations on the low pass filter characteristics, a tuning procedure is carried out in production. The same tunings must be performed if the RF ASIC N7501 is changed.

WCDMA transmitter

In the transmitter side, an analogue I/Q modulated signal is received from the digital baseband into N7501 and fed through the low pass filter.

The corner frequency of the filter is set to approximately 3 MHz.

After the filter the signal is fed to the IQ modulator, which converts the signal to final Tx frequency. There are two separate I/Q modulators. One for WCDMA and another for EGSM900 and GSM1800/1900 signals.

The modulator is followed by two VGA stages giving 85 dB of gain control range. The signal then exits N7501 via a balanced line. In order to attenuate the out of band noise of the transmitter the signal is band pass filtered by a SAW filter before it is fed to the WCDMA PA module.

After the PA the transmitted WCDMA signal is fed through an isolator and a duplex filter to the antenna.

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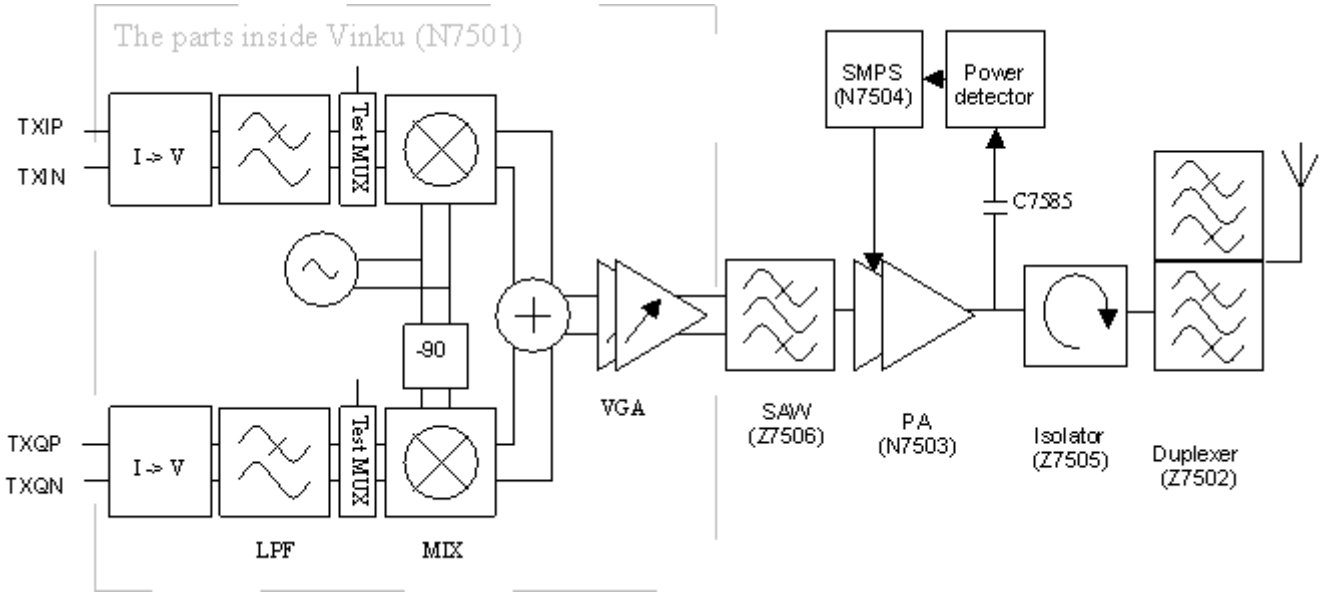

Figure 116 WCDMA transmitter

WCDMA power control

WCDMA Tx power control is accomplished by the two VGA amplifier stages in N7500 Tx ASIC.

The VGAs have a common temperature compensation circuit and one voltage mode analogue input for gain control (TXC).

The gain of VGA amplifier chain is controlled by a DA converter in BB. The same DA converter is shared by GSM Tx power control function.

It is required that phone can measure its output power in high power levels. A sample of the output power is taken by a capacitor between the power amplifier and the isolator and fed to a diode power detector. The output of the detector is low pass filtered and the voltage is then AD converted in BB. The power detector circuitry is calibrated in manufacturing.

Another function of the detector voltage is to steer the DC/DC converter, which is providing a variable supply voltage for the WCDMA PA.

WCDMA PA module

WCDMA PA is housed in a separate module having

- a variable supply voltage input for the amplifier stages (Vcc11),
- a battery supply voltage for the bias circuits (Vcc12),
- and two bias current inputs.

Bias currents are generated by 5-bit DA converters in N7501 RF ASIC. The converters are controlled by BB via RFBus.

In production the PA quiescent current is set according to PA vendor's specifications. If another PA is changed to the phone, this setting must be set again.

The bias currents are also used as PA on/off controls. The structure of the WCDMA PA is shown in the following figure. The supply voltage for the output stage is got from a DCDC converter in order to improve the efficiency at low power levels.

PA DCDC converter

The control of the DCDC converter is fed back from the power detector circuit.

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The DCDC converter limits the lowest supply voltage to 1.5 V. At highest power levels the DCDC converter output settles nominally to 3.2 V.

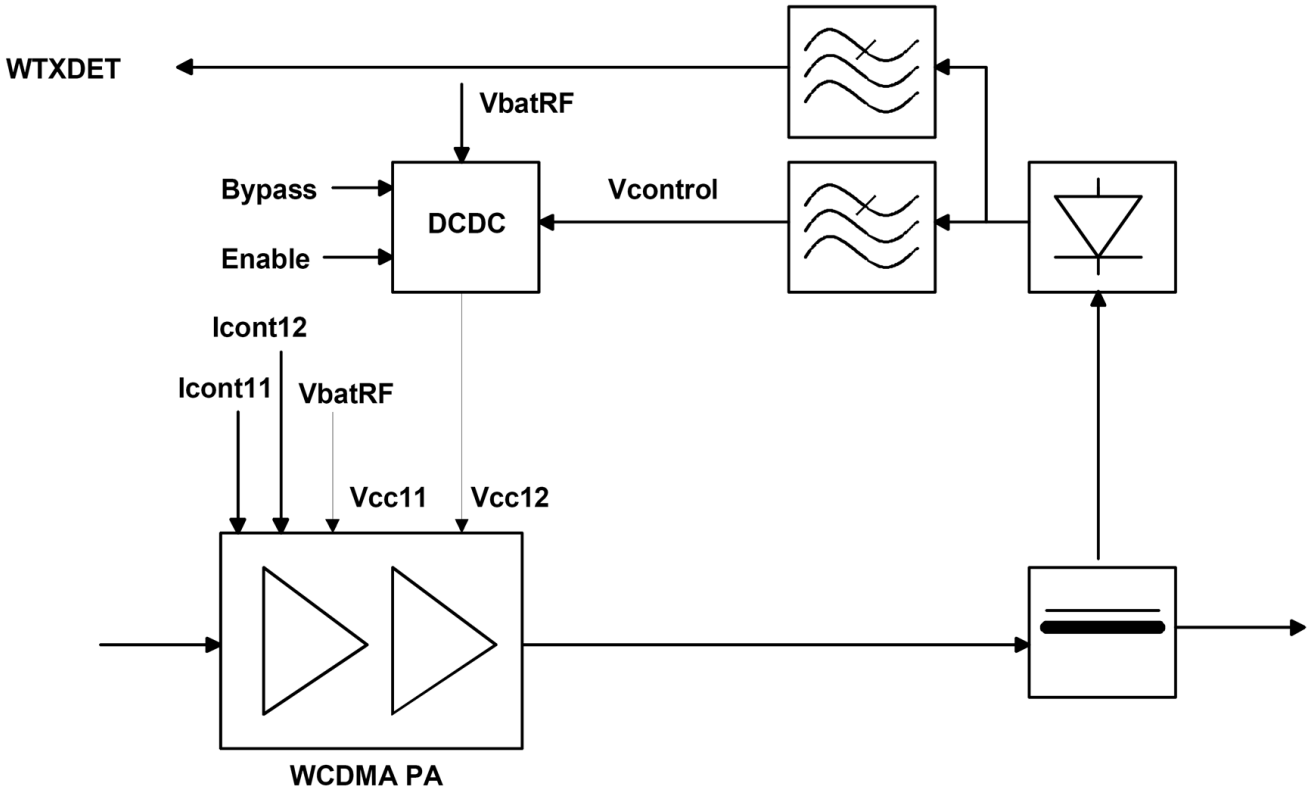

Figure 117 Block diagram of DCDC converter and WCDMA PA

GSM transmitter

An analogue IQ modulated signal is received to N7501 from digital BB.

The signal is first low pass filtered with filter corner frequency set to approximately 200 kHz. After the filter, the signal is routed to the GSM modulator.

The appropriate routing after the modulator is selected by biasing either EGSM900 or GSM1800/1900 variable gain amplifier. The amplifier gives 40 dB of power control dynamic range.

After the VGA stage the signal exits N7501. In case of GSM1800/1900 the signal goes directly to the GSM PA module. In case of EGSM900, the PA module is preceded by a SAW filter. After the filter, the signal is fed to GSM PA module. Finally the signal is routed via antenna switch to the antenna.

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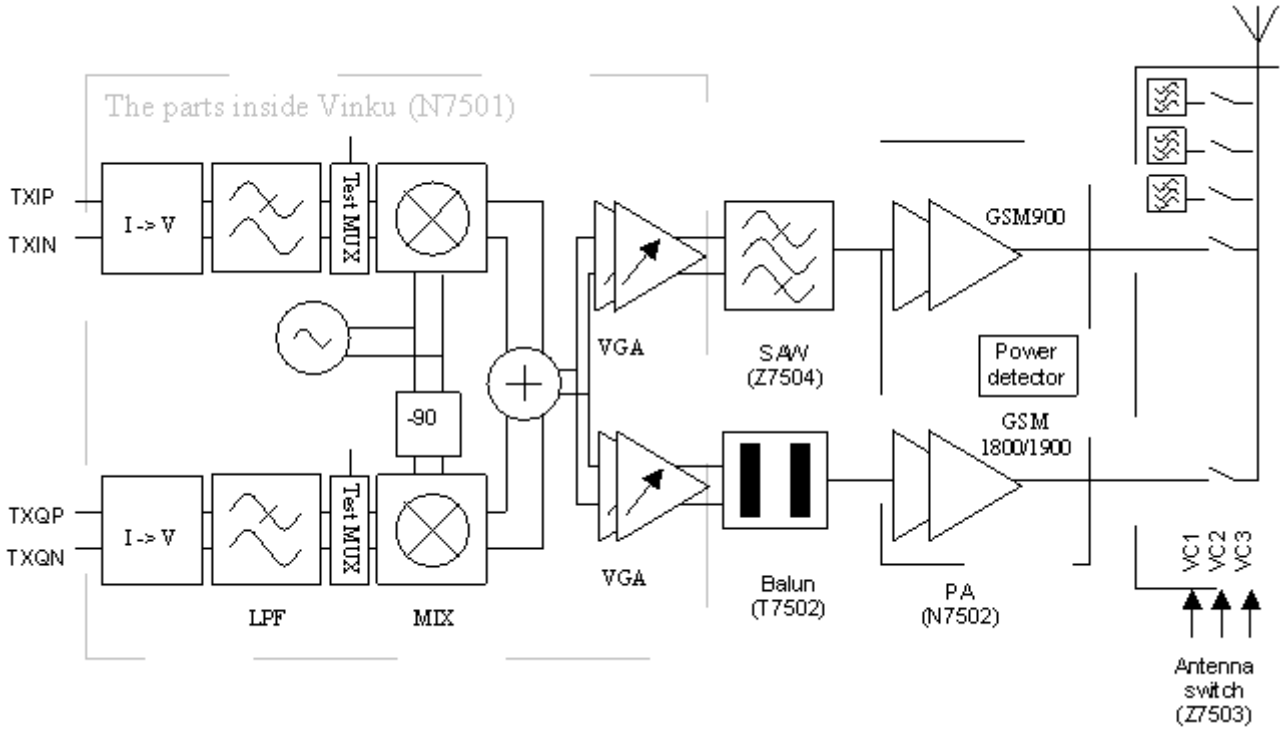

Figure 118 GSM transmitter

GSM power control

A closed control loop comprise an integrated power detector (in PA module) and an error amplifier. The error amplifier resides in N7501, and it controls the transmitter power of GSM.

Detector output from the PA gives a DC level proportional to the output power. The DC voltage is fed to the negative input of the error amplifier, where it is compared to the level of the reference signal, TXC. TXC is got from the BB circuitry. The output of the error amplifier is fed to a buffer amplifier, which in turn steers the VGA amplifier.

The TXC signal also contains the output power ramp waveform, which is optimized in order to meet the transient spectrum and burst timing requirements. PA is switched on and off by changing the bias currents. As a result the output power ramping and final power level of the transmitter are set in a controlled manner.

During EDGE operation 8-PSK modulation is utilized. In the 8-PSK modulation, there are envelope variations during the data transmission. This presents extra requirement to the linearity of the PA. Therefore the PA is set to a dedicated EDGE mode by setting a specific mode control signal up (Vmode). The bias currents are also adjusted in order to improve the linearity.

Because of the 8-PSK modulation, the power control loop has to be opened during the data transmission in EDGE mode. Otherwise a part of the envelope variations could be canceled out by control loop and signal information contents and spectrum would be deteriorated. Loop is opened with a dedicated TXA-signal via RFBus. When the power is ramped up, a modulating bit sequence producing a constant envelope waveform is used and the power control loop is closed. Once the wanted power level has been reached, the loop is opened and the power control voltage is kept constant by a capacitor integrated to N7501 Tx ASIC. When the active part of the burst is over, the loop is again closed and the power is ramped down. The TXA signal is disabled during GMSK transmission.

Power control loop is enabled and disabled by writing an appropriate register in N7501 RF ASIC. In case of dual slot transmission, the output power is ramped down between the consecutive slots.

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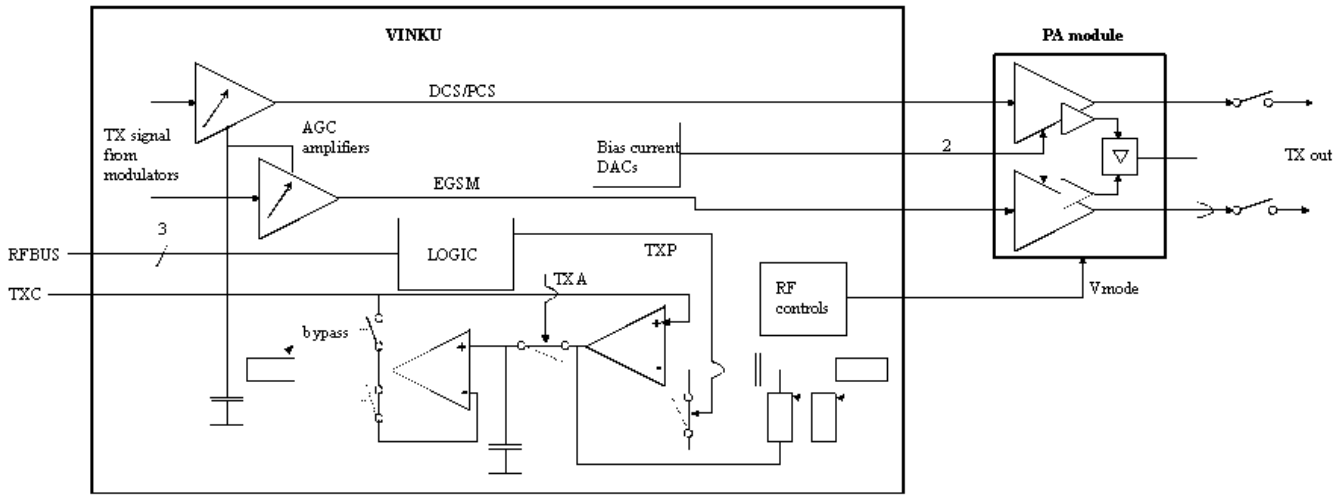

Figure 119 GSM/EDGE power control topology and control signals

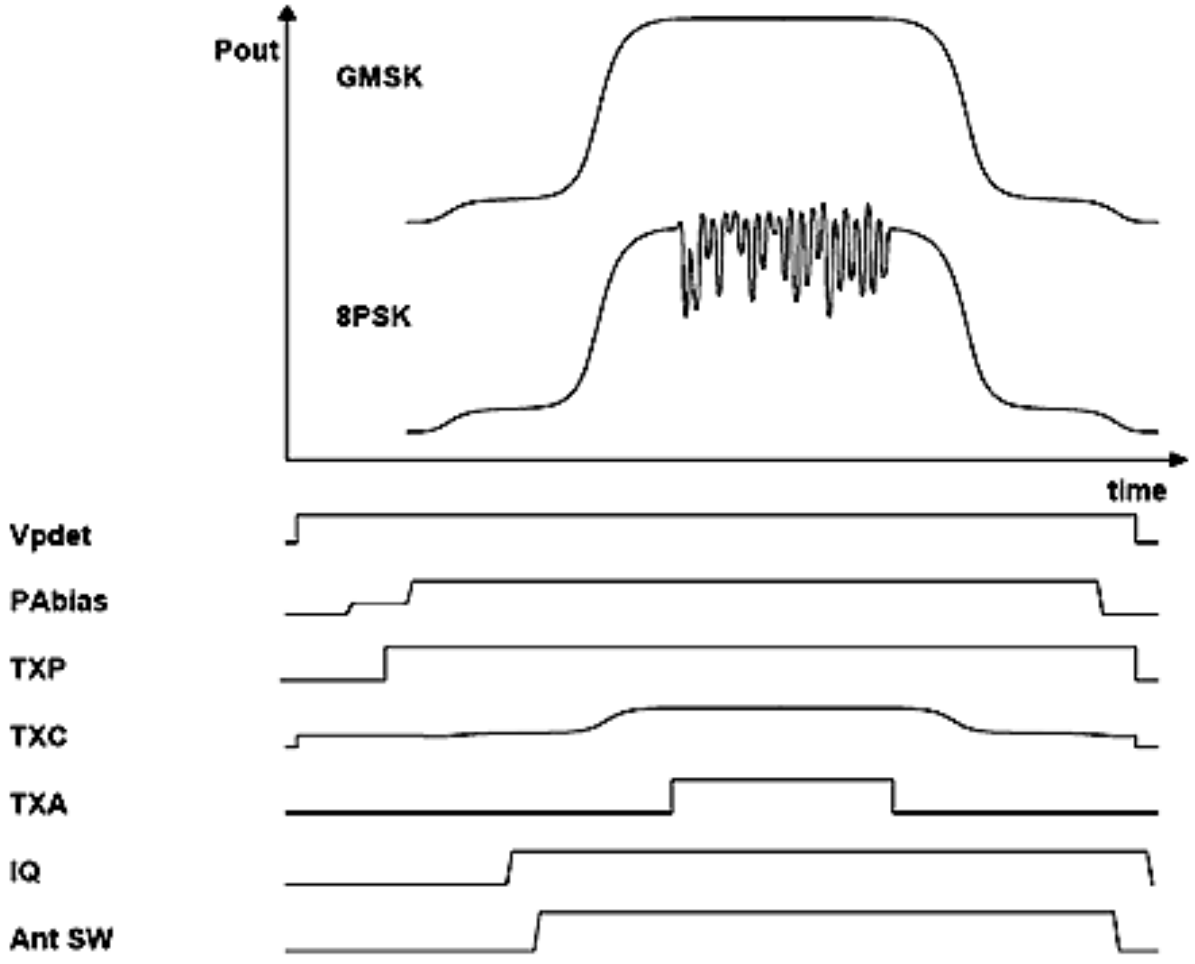

Figure 120 Power control signal usage in GSM (GMSK) and EDGE (8PSK) transmission. Timings are not shown accurately

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GSM PA module

A single GSM/EDGE PA module contains two separate amplifier chains, one for EGSM900 and another for GSM1800/1900. Both amplifiers have a battery supply connection and two bias current inputs. The bias current for final amplifier stage is adjusted according the power level in use in order to optimise efficiency. The bias currents are also used as on/off switching signals for PAs.

In the EDGE mode, PA linearity has to be higher than in GMSK mode because of envelope variations of the 8-PSK modulations. This is achieved by increasing the bias currents compared to the GMSK mode and setting a dedicated Vmode control signal up. Increasing bias currents improves the linearity of the amplifiers, but it also tends to unnecessarily increase the gain of the PA. Vmode control aims to keep the gain of the amplifiers down.

The bias current needed for the maximum and the lowest output powers is specified by a PA manufacturer. The current for the intermediate power levels is then linearly adjusted between these two values.

PA detection

It is possible to use PAs manufactured by different vendors. Because of this it is possible to set manufacturer specific bias values for the PA. PA is detected by DSP SW in manufacturing phase. If PA is changed this detection routine must be rerun before Tx calibrations. Components R7518, R7522, R7528 and R7534 are part of PA version detection circuitry.

Frequency synthesizers

RF has separate synthesizers for Rx and Tx. Both synthesizers consist of:

- PLL
- loop filter
- VCO
- balun

The VCO frequencies are locked by PLLs into a reference oscillator, VCTCXO.

The PLLs are located in N7500 and N7501 respectively and controlled via RFBus. PLL charge pump charges or discharges the integrator capacitor in the loop filter depending on the phase of the measured frequency compared to the phase of the reference frequency. The integrator output voltage is connected to the control input of the VCO.

The VCOs operate at the channel frequency multiplied by two in GSM1800/1900/WCDMA and by four in EGSM900. The required frequency dividers required for modulators are integrated in N7501 and those for demodulators in N7500. The dividers are controlled via RFBus.

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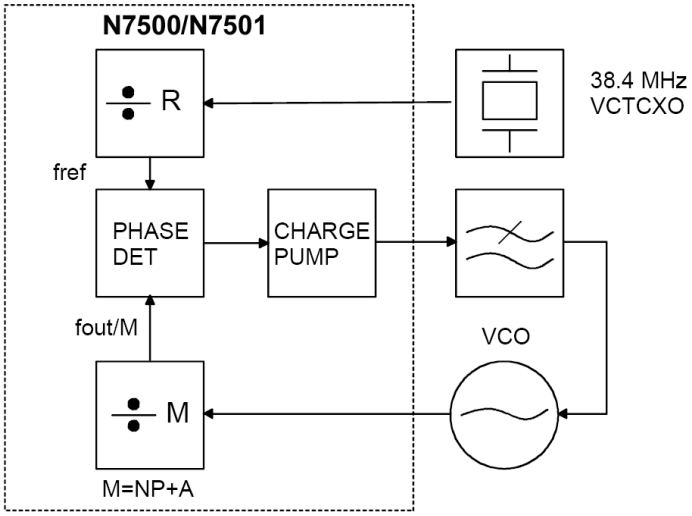

Figure 121 Phase locked loop in N7500 and N7501 (PLL)

Reference oscillators

As a reference oscillator for the frequency synthesizers a 38.4MHz VCTCXO (voltage controlled temperature compensated crystal oscillator) is used.

The output signal of the VCTCXO is directly connected to both N7500 and N7501 where it's used as synthesizer reference. N7500 also contains a balanced buffered output for supplying the clock signal to the digital BB ASIC and a single ended buffer for Bluetooth.

The frequency of the reference oscillator is locked into the frequency of the base station with the help of an AFC voltage, which is generated in BB by DSP and converted by dedicated DAC.

Regulators

N7500 and N7501 contain integrated regulators to supply regulated voltages for their internal circuitry and other RF parts. Rx VCO supply is got via a switch from N7500 VR1 regulator. VCO can be switched on and off by controlling the switch via RFBus.

Supply voltage for the VCTCXO is provided by a BB mixed mode ASIC. The same supply is used for reference clock input buffers (in N7500 and N7501), output buffers (from N7500 to BB) and for the digital control blocks of both RF ASICs. When the VCTCXO regulator is set active, the control blocks of the RF ASICs also wake up. After that the integrated regulators can be controlled via RFBus.

Other supplies, like 4.7V supply for PLL charge pumps and bias reference (VREFRF01) are also provided by the BB mixed mode ASIC.

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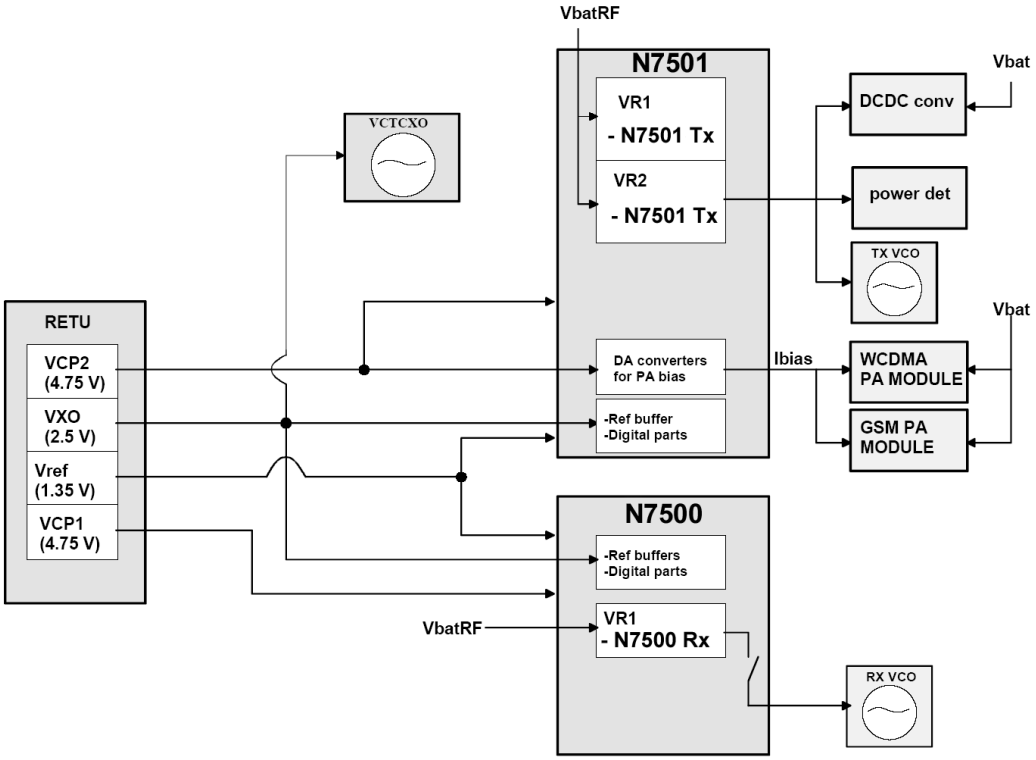

Figure 122 RF supply connections from the BB mixed mode ASIC

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Frequency mappings

EGSM900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
975	880,2	925,2	3520,8	3700,8	1	890,2	935,2	3560,8	3740,8	63	902,6	947,6	3610,4	3790,4
976	880,4	925,4	3521,6	3701,6	2	890,4	935,4	3561,6	3741,6	64	902,8	947,8	3611,2	3791,2
977	880,6	925,6	3522,4	3702,4	3	890,6	935,6	3562,4	3742,4	65	903,0	948,0	3612,0	3792,0
978	880,8	925,8	3523,2	3703,2	4	890,8	935,8	3563,2	3743,2	66	903,2	948,2	3612,8	3792,8
979	881,0	926,0	3524,0	3704,0	5	891,0	936,0	3564,0	3744,0	67	903,4	948,4	3613,6	3793,6
980	881,2	926,2	3524,8	3704,8	6	891,2	936,2	3564,8	3744,8	68	903,6	948,6	3614,4	3794,4
981	881,4	926,4	3525,6	3705,6	7	891,4	936,4	3565,6	3745,6	69	903,8	948,8	3615,2	3795,2
982	881,6	926,6	3526,4	3706,4	8	891,6	936,6	3566,4	3746,4	70	904,0	949,0	3616,0	3796,0
983	881,8	926,8	3527,2	3707,2	9	891,8	936,8	3567,2	3747,2	71	904,2	949,2	3616,8	3796,8
984	882,0	927,0	3528,0	3708,0	10	892,0	937,0	3568,0	3748,0	72	904,4	949,4	3617,6	3797,6
985	882,2	927,2	3528,8	3708,8	11	892,2	937,2	3568,8	3748,8	73	904,6	949,6	3618,4	3798,4
986	882,4	927,4	3529,6	3709,6	12	892,4	937,4	3569,6	3749,6	74	904,8	949,8	3619,2	3799,2
987	882,6	927,6	3530,4	3710,4	13	892,6	937,6	3570,4	3750,4	75	905,0	950,0	3620,0	3800,0
988	882,8	927,8	3531,2	3711,2	14	892,8	937,8	3571,2	3751,2	76	905,2	950,2	3620,8	3800,8
989	883,0	928,0	3532,0	3712,0	15	893,0	938,0	3572,0	3752,0	77	905,4	950,4	3621,6	3801,6
990	883,2	928,2	3532,8	3712,8	16	893,2	938,2	3572,8	3752,8	78	905,6	950,6	3622,4	3802,4
991	883,4	928,4	3533,6	3713,6	17	893,4	938,4	3573,6	3753,6	79	905,8	950,8	3623,2	3803,2
992	883,6	928,6	3534,4	3714,4	18	893,6	938,6	3574,4	3754,4	80	906,0	951,0	3624,0	3804,0
993	883,8	928,8	3535,2	3715,2	19	893,8	938,8	3575,2	3755,2	81	906,2	951,2	3624,8	3804,8
994	884,0	929,0	3536,0	3716,0	20	894,0	939,0	3576,0	3756,0	82	906,4	951,4	3625,6	3805,6
995	884,2	929,2	3536,8	3716,8	21	894,2	939,2	3576,8	3756,8	83	906,6	951,6	3626,4	3806,4
996	884,4	929,4	3537,6	3717,6	22	894,4	939,4	3577,6	3757,6	84	906,8	951,8	3627,2	3807,2
997	884,6	929,6	3538,4	3718,4	23	894,6	939,6	3578,4	3758,4	85	907,0	952,0	3628,0	3808,0
998	884,8	929,8	3539,2	3719,2	24	894,8	939,8	3579,2	3759,2	86	907,2	952,2	3628,8	3808,8
999	885,0	930,0	3540,0	3720,0	25	895,0	940,0	3580,0	3760,0	87	907,4	952,4	3629,6	3809,6
1000	885,2	930,2	3540,8	3720,8	26	895,2	940,2	3580,8	3760,8	88	907,6	952,6	3630,4	3810,4
1001	885,4	930,4	3541,6	3721,6	27	895,4	940,4	3581,6	3761,6	89	907,8	952,8	3631,2	3811,2
1002	885,6	930,6	3542,4	3722,4	28	895,6	940,6	3582,4	3762,4	90	908,0	953,0	3632,0	3812,0
1003	885,8	930,8	3543,2	3723,2	29	895,8	940,8	3583,2	3763,2	91	908,2	953,2	3632,8	3812,8
1004	886,0	931,0	3544,0	3724,0	30	896,0	941,0	3584,0	3764,0	92	908,4	953,4	3633,6	3813,6
1005	886,2	931,2	3544,8	3724,8	31	896,2	941,2	3584,8	3764,8	93	908,6	953,6	3634,4	3814,4
1006	886,4	931,4	3545,6	3725,6	32	896,4	941,4	3585,6	3765,6	94	908,8	953,8	3635,2	3815,2
1007	886,6	931,6	3546,4	3726,4	33	896,6	941,6	3586,4	3766,4	95	909,0	954,0	3636,0	3816,0
1008	886,8	931,8	3547,2	3727,2	34	896,8	941,8	3587,2	3767,2	96	909,2	954,2	3636,8	3816,8
1009	887,0	932,0	3548,0	3728,0	35	897,0	942,0	3588,0	3768,0	97	909,4	954,4	3637,6	3817,6
1010	887,2	932,2	3548,8	3728,8	36	897,2	942,2	3588,8	3768,8	98	909,6	954,6	3638,4	3818,4
1011	887,4	932,4	3549,6	3729,6	37	897,4	942,4	3589,6	3769,6	99	909,8	954,8	3639,2	3819,2
1012	887,6	932,6	3550,4	3730,4	38	897,6	942,6	3590,4	3770,4	100	910,0	955,0	3640,0	3820,0
1013	887,8	932,8	3551,2	3731,2	39	897,8	942,8	3591,2	3771,2	101	910,2	955,2	3640,8	3820,8
1014	888,0	933,0	3552,0	3732,0	40	898,0	943,0	3592,0	3772,0	102	910,4	955,4	3641,6	3821,6
1015	888,2	933,2	3552,8	3732,8	41	898,2	943,2	3592,8	3772,8	103	910,6	955,6	3642,4	3822,4
1016	888,4	933,4	3553,6	3733,6	42	898,4	943,4	3593,6	3773,6	104	910,8	955,8	3643,2	3823,2
1017	888,6	933,6	3554,4	3734,4	43	898,6	943,6	3594,4	3774,4	105	911,0	956,0	3644,0	3824,0
1018	888,8	933,8	3555,2	3735,2	44	898,8	943,8	3595,2	3775,2	106	911,2	956,2	3644,8	3824,8
1019	889,0	934,0	3556,0	3736,0	45	899,0	944,0	3596,0	3776,0	107	911,4	956,4	3645,6	3825,6
1020	889,2	934,2	3556,8	3736,8	46	899,2	944,2	3596,8	3776,8	108	911,6	956,6	3646,4	3826,4
1021	889,4	934,4	3557,6	3737,6	47	899,4	944,4	3597,6	3777,6	109	911,8	956,8	3647,2	3827,2
1022	889,6	934,6	3558,4	3738,4	48	899,6	944,6	3598,4	3778,4	110	912,0	957,0	3648,0	3828,0
1023	889,8	934,8	3559,2	3739,2	49	899,8	944,8	3599,2	3779,2	111	912,2	957,2	3648,8	3828,8
0	890,0	935,0	3560,0	3740,0	50	900,0	945,0	3600,0	3780,0	112	912,4	957,4	3649,6	3829,6
					51	900,2	945,2	3600,8	3780,8	113	912,6	957,6	3650,4	3830,4
					52	900,4	945,4	3601,6	3781,6	114	912,8	957,8	3651,2	3831,2
					53	900,6	945,6	3602,4	3782,4	115	913,0	958,0	3652,0	3832,0
					54	900,8	945,8	3603,2	3783,2	116	913,2	958,2	3652,8	3832,8
					55	901,0	946,0	3604,0	3784,0	117	913,4	958,4	3653,6	3833,6
					56	901,2	946,2	3604,8	3784,8	118	913,6	958,6	3654,4	3834,4
					57	901,4	946,4	3605,6	3785,6	119	913,8	958,8	3655,2	3835,2
					58	901,6	946,6	3606,4	3786,4	120	914,0	959,0	3656,0	3836,0
					59	901,8	946,8	3607,2	3787,2	121	914,2	959,2	3656,8	3836,8
					60	902,0	947,0	3608,0	3788,0	122	914,4	959,4	3657,6	3837,6
					61	902,2	947,2	3608,8	3788,8	123	914,6	959,6	3658,4	3838,4
					62	902,4	947,4	3609,6	3789,6	124	914,8	959,8	3659,2	3839,2

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GSM1800 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
512	1710.2	1805.2	3420.4	3610.4	606	1729.0	1824.0	3458.0	3648.0	700	1747.8	1842.8	3495.6	3685.6	794	1766.6	1861.6	3533.2	3723.2
513	1710.4	1805.4	6841.6	7221.6	607	1729.2	1824.2	3458.4	3648.4	701	1748.0	1843.0	3496.0	3686.0	795	1766.8	1861.8	3533.6	3723.6
514	1710.6	1805.6	6842.4	7222.4	608	1729.4	1824.4	3458.8	3648.8	702	1748.2	1843.2	3496.4	3686.4	796	1767.0	1862.0	3534.0	3724.0
515	1710.8	1805.8	6843.2	7223.2	609	1729.6	1824.6	3459.2	3649.2	703	1748.4	1843.4	3496.8	3686.8	797	1767.2	1862.2	3534.4	3724.4
516	1711.0	1806.0	6844.0	7224.0	610	1729.8	1824.8	3459.6	3649.6	704	1748.6	1843.6	3497.2	3687.2	798	1767.4	1862.4	3534.8	3724.8
517	1711.2	1806.2	6844.8	7224.8	611	1730.0	1825.0	3460.0	3650.0	705	1748.8	1843.8	3497.6	3687.6	799	1767.6	1862.6	3535.2	3725.2
518	1711.4	1806.4	6845.6	7225.6	612	1730.2	1825.2	3460.4	3650.4	706	1749.0	1844.0	3498.0	3688.0	800	1767.8	1862.8	3535.6	3725.6
519	1711.6	1806.6	6846.4	7226.4	613	1730.4	1825.4	3460.8	3650.8	707	1749.2	1844.2	3498.4	3688.4	801	1768.0	1863.0	3536.0	3726.0
520	1711.8	1806.8	6847.2	7227.2	614	1730.6	1825.6	3461.2	3651.2	708	1749.4	1844.4	3498.8	3688.8	802	1768.2	1863.2	3536.4	3726.4
521	1712.0	1807.0	6848.0	7228.0	615	1730.8	1825.8	3461.6	3651.6	709	1749.6	1844.6	3499.2	3689.2	803	1768.4	1863.4	3536.8	3726.8
522	1712.2	1807.2	6848.8	7228.8	616	1731.0	1826.0	3462.0	3652.0	710	1749.8	1844.8	3499.6	3689.6	804	1768.6	1863.6	3537.2	3727.2
523	1712.4	1807.4	6849.6	7229.6	617	1731.2	1826.2	3462.4	3652.4	711	1750.0	1845.0	3500.0	3690.0	805	1768.8	1863.8	3537.6	3727.6
524	1712.6	1807.6	6850.4	7230.4	618	1731.4	1826.4	3462.8	3652.8	712	1750.2	1845.2	3500.4	3690.4	806	1769.0	1864.0	3538.0	3728.0
525	1712.8	1807.8	6851.2	7231.2	619	1731.6	1826.6	3463.2	3653.2	713	1750.4	1845.4	3500.8	3690.8	807	1769.2	1864.2	3538.4	3728.4
526	1713.0	1808.0	6852.0	7232.0	620	1731.8	1826.8	3463.6	3653.6	714	1750.6	1845.6	3501.2	3691.2	808	1769.4	1864.4	3538.8	3728.8
527	1713.2	1808.2	6852.8	7232.8	621	1732.0	1827.0	3464.0	3654.0	715	1750.8	1845.8	3501.6	3691.6	809	1769.6	1864.6	3539.2	3729.2
528	1713.4	1808.4	6853.6	7233.6	622	1732.2	1827.2	3464.4	3654.4	716	1751.0	1846.0	3502.0	3692.0	810	1769.8	1864.8	3539.6	3729.6
529	1713.6	1808.6	6854.4	7234.4	623	1732.4	1827.4	3464.8	3654.8	717	1751.2	1846.2	3502.4	3692.4	811	1770.0	1865.0	3540.0	3730.0
530	1713.8	1808.8	6855.2	7235.2	624	1732.6	1827.6	3465.2	3655.2	718	1751.4	1846.4	3502.8	3692.8	812	1770.2	1865.2	3540.4	3730.4
531	1714.0	1809.0	6856.0	7236.0	625	1732.8	1827.8	3465.6	3655.6	719	1751.6	1846.6	3503.2	3693.2	813	1770.4	1865.4	3540.8	3730.8
532	1714.2	1809.2	6856.8	7236.8	626	1733.0	1828.0	3466.0	3656.0	720	1751.8	1846.8	3503.6	3693.6	814	1770.6	1865.6	3541.2	3731.2
533	1714.4	1809.4	6857.6	7237.6	627	1733.2	1828.2	3466.4	3656.4	721	1752.0	1847.0	3504.0	3694.0	815	1770.8	1865.8	3541.6	3731.6
534	1714.6	1809.6	6858.4	7238.4	628	1733.4	1828.4	3466.8	3656.8	722	1752.2	1847.2	3504.4	3694.4	816	1771.0	1866.0	3542.0	3732.0
535	1714.8	1809.8	6859.2	7239.2	629	1733.6	1828.6	3467.2	3657.2	723	1752.4	1847.4	3504.8	3694.8	817	1771.2	1866.2	3542.4	3732.4
536	1715.0	1810.0	6860.0	7240.0	630	1733.8	1828.8	3467.6	3657.6	724	1752.6	1847.6	3505.2	3695.2	818	1771.4	1866.4	3542.8	3732.8
537	1715.2	1810.2	6860.8	7240.8	631	1734.0	1829.0	3468.0	3658.0	725	1752.8	1847.8	3505.6	3695.6	819	1771.6	1866.6	3543.2	3733.2
538	1715.4	1810.4	6861.6	7241.6	632	1734.2	1829.2	3468.4	3658.4	726	1753.0	1848.0	3506.0	3696.0	820	1771.8	1866.8	3543.6	3733.6
539	1715.6	1810.6	6862.4	7242.4	633	1734.4	1829.4	3468.8	3658.8	727	1753.2	1848.2	3506.4	3696.4	821	1772.0	1867.0	3544.0	3734.0
540	1715.8	1810.8	6863.2	7243.2	634	1734.6	1829.6	3469.2	3659.2	728	1753.4	1848.4	3506.8	3696.8	822	1772.2	1867.2	3544.4	3734.4
541	1716.0	1811.0	6864.0	7244.0	635	1734.8	1829.8	3469.6	3659.6	729	1753.6	1848.6	3507.2	3697.2	823	1772.4	1867.4	3544.8	3734.8
542	1716.2	1811.2	6864.8	7244.8	636	1735.0	1830.0	3470.0	3660.0	730	1753.8	1848.8	3507.6	3697.6	824	1772.6	1867.6	3545.2	3735.2
543	1716.4	1811.4	6865.6	7245.6	637	1735.2	1830.2	3470.4	3660.4	731	1754.0	1849.0	3508.0	3698.0	825	1772.8	1867.8	3545.6	3735.6
544	1716.6	1811.6	6866.4	7246.4	638	1735.4	1830.4	3470.8	3660.8	732	1754.2	1849.2	3508.4	3698.4	826	1773.0	1868.0	3546.0	3736.0
545	1716.8	1811.8	6867.2	7247.2	639	1735.6	1830.6	3471.2	3661.2	733	1754.4	1849.4	3508.8	3698.8	827	1773.2	1868.2	3546.4	3736.4
546	1717.0	1812.0	6868.0	7248.0	640	1735.8	1830.8	3471.6	3661.6	734	1754.6	1849.6	3509.2	3699.2	828	1773.4	1868.4	3546.8	3736.8
547	1717.2	1812.2	6868.8	7248.8	641	1736.0	1831.0	3472.0	3662.0	735	1754.8	1849.8	3509.6	3699.6	829	1773.6	1868.6	3547.2	3737.2
548	1717.4	1812.4	6869.6	7249.6	642	1736.2	1831.2	3472.4	3662.4	736	1755.0	1850.0	3510.0	3700.0	830	1773.8	1868.8	3547.6	3737.6
549	1717.6	1812.6	6870.4	7250.4	643	1736.4	1831.4	3472.8	3662.8	737	1755.2	1850.2	3510.4	3700.4	831	1774.0	1869.0	3548.0	3738.0
550	1717.8	1812.8	6871.2	7251.2	644	1736.6	1831.6	3473.2	3663.2	738	1755.4	1850.4	3510.8	3700.8	832	1774.2	1869.2	3548.4	3738.4
551	1718.0	1813.0	6872.0	7252.0	645	1736.8	1831.8	3473.6	3663.6	739	1755.6	1850.6	3511.2	3701.2	833	1774.4	1869.4	3548.8	3738.8
552	1718.2	1813.2	6872.8	7252.8	646	1737.0	1832.0	3474.0	3664.0	740	1755.8	1850.8	3511.6	3701.6	834	1774.6	1869.6	3549.2	3739.2
553	1718.4	1813.4	6873.6	7253.6	647	1737.2	1832.2	3474.4	3664.4	741	1756.0	1851.0	3512.0	3702.0	835	1774.8	1869.8	3549.6	3739.6
554	1718.6	1813.6	6874.4	7254.4	648	1737.4	1832.4	3474.8	3664.8	742	1756.2	1851.2	3512.4	3702.4	836	1775.0	1870.0	3550.0	3740.0
555	1718.8	1813.8	6875.2	7255.2	649	1737.6	1832.6	3475.2	3665.2	743	1756.4	1851.4	3512.8	3702.8	837	1775.2	1870.2	3550.4	3740.4
556	1719.0	1814.0	6876.0	7256.0	650	1737.8	1832.8	3475.6	3665.6	744	1756.6	1851.6	3513.2	3703.2	838	1775.4	1870.4	3550.8	3740.8
557	1719.2	1814.2	6876.8	7256.8	651	1738.0	1833.0	3476.0	3666.0	745	1756.8	1851.8	3513.6	3703.6	839	1775.6	1870.6	3551.2	3741.2
558	1719.4	1814.4	6877.6	7257.6	652	1738.2	1833.2	3476.4	3666.4	746	1757.0	1852.0	3514.0	3704.0	840	1775.8	1870.8	3551.6	3741.6
559	1719.6	1814.6	6878.4	7258.4	653	1738.4	1833.4	3476.8	3666.8	747	1757.2	1852.2	3514.4	3704.4	841	1776.0	1871.0	3552.0	3742.0
560	1719.8	1814.8	6879.2	7259.2	654	1738.6	1833.6	3477.2	3667.2	748	1757.4	1852.4	3514.8	3704.8	842	1776.2	1871.2	3552.4	3742.4
561	1720.0	1815.0	6880.0	7260.0	655	1738.8	1833.8	3477.6	3667.6	749	1757.6	1852.6	3515.2	3705.2	843	1776.4	1871.4	3552.8	3742.8
562	1720.2	1815.2	6880.8	7260.8	656	1739.0	1834.0	3478.0	3668.0	750	1757.8	1852.8	3515.6	3705.6	844	1776.6	1871.6	3553.2	3743.2
563	1720.4	1815.4	6881.6	7261.6	657	1739.2	1834.2	3478.4	3668.4	751	1758.0	1853.0	3516.0	3706.0	845	1776.8	1871.8	3553.6	3743.6
564	1720.6	1815.6	6882.4	7262.4	658	1739.4	1834.4	3478.8	3668.8	752	1758.2	1853.2	3516.4	3706.4	846	1777.0	1872.0	3554.0	3744.0
565	1720.8	1815.8	6883.2	7263.2	659	1739.6	1834.6	3479.2	3669.2	753	1758.4	1853.4	3516.8	3706.8	847	1777.2	1872.2	3554.4	3744.4
566	1721.0	1816.0	6884.0	7264.0	660	1739.8	1834.8	3479.6	3669.6	754	1758.6	1853.6	3517.2	3707.2	848	1777.4	1872.4	3554.8	3744.8
567	1721.2	1816.2	6884.8	7264.8	661	1740.0	1835.0	3480.0	3670.0	755	1758.8	1853.8	3517.6	3707.6	849	1777.6	1872.6	3555.2	3745.2
568	1721.4	1816.4	6885.6	7265.6	662	1740.2	1835.2	3480.4	3670.4	756	1759.0	1854.0	3518.0	3708.0	850	1777.8	1872.8	3555.6	3745.6
569	1721.6	1816.6	6886.4	7266.4	663	1740.4	1835.4	3480.8	3670.8	757	1759.2	1854.2	3518.4	3708.4	851	1778.0	1873.0	3556.0	3746.0
570	1721.8	1816.8	6887.2	7267.2	664	1740.6	1835.6	3481.2	3671.2	758	1759.4	1854.4	3518.8	3708.8	852	1778.2	1873.2	3556.4	3746.4
571	1722.0	1817.0	6888.0	7268.0	665	1740.8	1835.8	3481.6	3671.6	759	1759.6	1854.6	3519.2	3709.2	853	1778.4	1873.4	3556.8	3746.8
572	1722.2	1817.2	6888.8	7268.8	666	1741.0	1836.0	3482.0	3672.0	760	1759.8	1854.8	3519.6	3709.6	854	1778.6	1873.6	3557.2	3747.2
573	1722.4	1817.4	6889.6	7269.6	667	1741.2	1836.2	3482.4	3672.4	761	1760.0	1855.0	3520.0	3710.0	855	1778.8	1873.8	3557.6	3747.6
574	1722.6	1817.6	6890.4	7270.4	668	1741.4	1836.4	3482.8	3672.8	762	1760.2	1855.2	3520.4	3710.4	856	1779.0	1874.0	3558.0	3748.0
575	1722,8	1817,8	6891,2	7271,2	669	1741,6	1836,6	3483,2	3673,2	763	1760,4	1855,4	3520,8	3710,8	857	1779,2	1874,2	3558,4	3748,4
576	1723,0	1818,0	6892,0	7272,0	670	1741,8	1836,8	3483,6	3673,6	764	1760,6	1855,6	3521,2	3711,2	858	1779,4	1874,4	3558,8	3748,8
577	1723,2	1818,2	6892,8	7272,8	671	1742,0	1837,0	3484,0	3674,0	765	1760,8	1855,8	3521,6	3711,6	859	1779,6	1874,6	3559,2	3749,2
578	1723,4	1818,4	6893,6	7273,6	672	1742,2	1837,2	3484,4	3674,4	766	1761,0	1856,0	3522,0	3712,0	860	1779,8	1874,8	3559,6	3749,6
579	1723,6	1818,6	6894,4	7274,4	673	1742,4	1837,4	3484,8	3674,8	767	1761,2	1856,2	3522,4	3712,4	861	1780,0	1875,0	3560,0	3750,0
580	1723,8	1818,8	6895,2	7275,2	674	1742,6	1837,6	3485,2	3675,2	768	1761,4	1856,4	3522,8	3712,8	862	1780,2	1875,2	3560,4	3750,4
581	1724,0	1819,0	6896,0	7276,0	675	1742,8	1837,8	3485,6	3675,6	769	1761,6	1856,6	3523,2	3713,2	863	1780,4	1875,4	3560,8	3750,8
582	1724,2	1819,2	6896,8	7276,8	676	1743,0	1838,0	3486,0	3676,0	770	1761,8	1856,8	3523,6	3713,6	864	1780,6	1875,6	3561,2	3751,2
583	1724,4	1819,4	6897,6	7277,6	677	1743,2	1838,2	3486,4	3676,4	771	1762,0	1857,0	3524,0	3714,0	865	1780,8	1875,8	3561,6	3751,6
584	1724,6	1819,6	6898,4	7278,4	678	1743,4	1838,4	3486,8	3676,8	772	1762,2	1857,2	3524,4	3714,4	866	1781,0	1876,0	3562,0	3752,0
585	1724,8	1819,8	6899,2	7279,2	679	1743,6	1838,6	3487,2	3677,2	773	1762,4	1857,4	3524,8	3714,8	867	1781,2	1876,2	3562,4	3752,4
586	1725,0	1820,0	6900,0	7280,0	680	1743,8	1838,8	3487,6	3677,6	774	1762,6	1857,6	3525,2	3715,2	868	1781,4	1876,4	3562,8	3752,8
587	1725,2	1820,2	6900,8	7280,8	681	1744,0	1839,0	3488,0	3678,0	775	1762,8	1857,8	3525,6	3715,6	869	1781,6	1876,6	3563,2	3753,2
588	1725,4	1820,4	6901,6	7281,6	682	1744,2	1839,2	3488,4	3678,4	776	1763,0	1858,0	3526,0	3716,0	870	1781,8	1876,8	3563,6	3753,6
589	1725,6	1820,6	6902,4	7282,4	683	1744,4	1839,4	3488,8	3678,8	777	1763,2	1858,2	3526,4	3716,4	871	1782,0	1877,0	3564,0	3754,0
590	1725,8	1820,8	6903,2	7283,2	684	1744,6	1839,6	3489,2	3679,2	778	1763,4	1858,4	3526,8	3716,8	872	1782,2	1877,2	3564,4	3754,4
591	1726,0	1821,0	6904,0	7284,0	685	1744,8	1839,8	3489,6	3679,6	779	1763,6	1858,6	3527,2	3717,2	873	1782,4	1877,4	3564,8	3754,8
592	1726,2	1821,2	6904,8	7284,8	686	1745,0	1840,0	3490,0	3680,0	780	1763,8	1858,8	3527,6	3717,6	874	1782,6	1877,6	3565,2	3755,2
593	1726,4	1821,4	6905,6	7285,6	687	1745,2	1840,2	3490,4	3680,4	781	1764,0	1859,0	3528,0	3718,0	875	1782,8	1877,8	3565,6	3755,6
594	1726,6	1821,6	6906,4	7286,4	688	1745,4	1840,4	3490,8	3680,8	782	1764,2	1859,2	3528,4	3718,4	876	1783,0	1878,0	3566,0	3756,0
595	1726,8	1821,8	6907,2	7287,2	689	1745,6	1840,6	3491,2	3681,2	783	1764,4	1859,4	3528,8	3718,8	877	1783,2	1878,2	3566,4	3756,4
596	1727,0	1822,0	6908,0	7288,0	690	1745,8	1840,8	3491,6	3681,6	784	1764,6	1859,6	3529,2	3719,2	878	1783,4	1878,4	3566,8	3756,8
597	1727,2	1822,2	6908,8	7288,8	691	1746,0	1841,0	3492,0	3682,0	785	1764,8	1859,8	3529,6	3719,6	879	1783,6	1878,6	3567,2	3757,2
598	1727,4	1822,4	6909,6	7289,6	692	1746,2	1841,2	3492,4	3682,4	786	1765,0	1860,0	3530,0	3720,0	880	1783,8	1878,8	3567,6	3757,6
599	1727,6	1822,6	6910,4	7290,4	693	1746,4	1841,4	3492,8	3682,8	787	1765,2	1860,2	3530,4	3720,4	881	1784,0	1879,0	3568,0	3758,0
600	1727,8	1822,8	6911,2	7291,2	694	1746,6	1841,6	3493,2	3683,2	788	1765,4	1860,4	3530,8	3720,8	882	1784,2	1879,2	3568,4	3758,4
601	1728,0	1823,0	6912,0	7292,0	695	1746,8	1841,8	3493,6	3683,6	789	1765,6	1860,6	3531,2	3721,2	883	1784,4	1879,4	3568,8	3758,8
602	1728,2	1823,2	6912,8	7292,8	696	1747,0	1842,0	3494,0	3684,0	790	1765,8	1860,8	3531,6	3721,6	884	1784,6	1879,6	3569,2	3759,2
603	1728,4	1823,4	6913,6	7293,6	697	1747,2	1842,2	3494,4	3684,4	791	1766,0	1861,0	3532,0	3722,0	885	1784,8	1879,8	3569,6	3759,6
604	1728,6	1823,6	6914,4	7294,4	698	1747,4	1842,4	3494,8	3684,8	792	1766,2	1861,2	3532,4	3722,4					
605	1728,8	1823,8	6915,2	7295,2	699	1747,6	1842,6	3495,2	3685,2	793	1766,4	1861,4	3532,8	3722,8					

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GSM1900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
512	1850,2	1930,2	3700,4	3860,4	606	1869,0	1949,0	3738,0	3898,0	700	1887,8	1967,8	3775,6	3935,6	794	1906,6	1986,6	3813,2	3973,2
513	1850,4	1930,4	3700,8	3860,8	607	1869,2	1949,2	3738,4	3898,4	701	1888,0	1968,0	3776,0	3936,0	795	1906,8	1986,8	3813,6	3973,6
514	1850,6	1930,6	3701,2	3861,2	608	1869,4	1949,4	3738,8	3898,8	702	1888,2	1968,2	3776,4	3936,4	796	1907,0	1987,0	3814,0	3974,0
515	1850,8	1930,8	3701,6	3861,6	609	1869,6	1949,6	3739,2	3899,2	703	1888,4	1968,4	3776,8	3936,8	797	1907,2	1987,2	3814,4	3974,4
516	1851,0	1931,0	3702,0	3862,0	610	1869,8	1949,8	3739,6	3899,6	704	1888,6	1968,6	3777,2	3937,2	798	1907,4	1987,4	3814,8	3974,8
517	1851,2	1931,2	3702,4	3862,4	611	1870,0	1950,0	3740,0	3900,0	705	1888,8	1968,8	3777,6	3937,6	799	1907,6	1987,6	3815,2	3975,2
518	1851,4	1931,4	3702,8	3862,8	612	1870,2	1950,2	3740,4	3900,4	706	1889,0	1969,0	3778,0	3938,0	800	1907,8	1987,8	3815,6	3975,6
519	1851,6	1931,6	3703,2	3863,2	613	1870,4	1950,4	3740,8	3900,8	707	1889,2	1969,2	3778,4	3938,4	801	1908,0	1988,0	3816,0	3976,0
520	1851,8	1931,8	3703,6	3863,6	614	1870,6	1950,6	3741,2	3901,2	708	1889,4	1969,4	3778,8	3938,8	802	1908,2	1988,2	3816,4	3976,4
521	1852,0	1932,0	3704,0	3864,0	615	1870,8	1950,8	3741,6	3901,6	709	1889,6	1969,6	3779,2	3939,2	803	1908,4	1988,4	3816,8	3976,8
522	1852,2	1932,2	3704,4	3864,4	616	1871,0	1951,0	3742,0	3902,0	710	1889,8	1969,8	3779,6	3939,6	804	1908,6	1988,6	3817,2	3977,2
523	1852,4	1932,4	3704,8	3864,8	617	1871,2	1951,2	3742,4	3902,4	711	1890,0	1970,0	3780,0	3940,0	805	1908,8	1988,8	3817,6	3977,6
524	1852,6	1932,6	3705,2	3865,2	618	1871,4	1951,4	3742,8	3902,8	712	1890,2	1970,2	3780,4	3940,4	806	1909,0	1989,0	3818,0	3978,0
525	1852,8	1932,8	3705,6	3865,6	619	1871,6	1951,6	3743,2	3903,2	713	1890,4	1970,4	3780,8	3940,8	807	1909,2	1989,2	3818,4	3978,4
526	1853,0	1933,0	3706,0	3866,0	620	1871,8	1951,8	3743,6	3903,6	714	1890,6	1970,6	3781,2	3941,2	808	1909,4	1989,4	3818,8	3978,8
527	1853,2	1933,2	3706,4	3866,4	621	1872,0	1952,0	3744,0	3904,0	715	1890,8	1970,8	3781,6	3941,6	809	1909,6	1989,6	3819,2	3979,2
528	1853,4	1933,4	3706,8	3866,8	622	1872,2	1952,2	3744,4	3904,4	716	1891,0	1971,0	3782,0	3942,0	810	1909,8	1989,8	3819,6	3979,6
529	1853,6	1933,6	3707,2	3867,2	623	1872,4	1952,4	3744,8	3904,8	717	1891,2	1971,2	3782,4	3942,4					
530	1853,8	1933,8	3707,6	3867,6	624	1872,6	1952,6	3745,2	3905,2	718	1891,4	1971,4	3782,8	3942,8					
531	1854,0	1934,0	3708,0	3868,0	625	1872,8	1952,8	3745,6	3905,6	719	1891,6	1971,6	3783,2	3943,2					
532	1854,2	1934,2	3708,4	3868,4	626	1873,0	1953,0	3746,0	3906,0	720	1891,8	1971,8	3783,6	3943,6					
533	1854,4	1934,4	3708,8	3868,8	627	1873,2	1953,2	3746,4	3906,4	721	1892,0	1972,0	3784,0	3944,0					
534	1854,6	1934,6	3709,2	3869,2	628	1873,4	1953,4	3746,8	3906,8	722	1892,2	1972,2	3784,4	3944,4					
535	1854,8	1934,8	3709,6	3869,6	629	1873,6	1953,6	3747,2	3907,2	723	1892,4	1972,4	3784,8	3944,8					
536	1855,0	1935,0	3710,0	3870,0	630	1873,8	1953,8	3747,6	3907,6	724	1892,6	1972,6	3785,2	3945,2					
537	1855,2	1935,2	3710,4	3870,4	631	1874,0	1954,0	3748,0	3908,0	725	1892,8	1972,8	3785,6	3945,6					
538	1855,4	1935,4	3710,8	3870,8	632	1874,2	1954,2	3748,4	3908,4	726	1893,0	1973,0	3786,0	3946,0					
539	1855,6	1935,6	3711,2	3871,2	633	1874,4	1954,4	3748,8	3908,8	727	1893,2	1973,2	3786,4	3946,4					
540	1855,8	1935,8	3711,6	3871,6	634	1874,6	1954,6	3749,2	3909,2	728	1893,4	1973,4	3786,8	3946,8					
541	1856,0	1936,0	3712,0	3872,0	635	1874,8	1954,8	3749,6	3909,6	729	1893,6	1973,6	3787,2	3947,2					
542	1856,2	1936,2	3712,4	3872,4	636	1875,0	1955,0	3750,0	3910,0	730	1893,8	1973,8	3787,6	3947,6					
543	1856,4	1936,4	3712,8	3872,8	637	1875,2	1955,2	3750,4	3910,4	731	1894,0	1974,0	3788,0	3948,0					
544	1856,6	1936,6	3713,2	3873,2	638	1875,4	1955,4	3750,8	3910,8	732	1894,2	1974,2	3788,4	3948,4					
545	1856,8	1936,8	3713,6	3873,6	639	1875,6	1955,6	3751,2	3911,2	733	1894,4	1974,4	3788,8	3948,8					
546	1857,0	1937,0	3714,0	3874,0	640	1875,8	1955,8	3751,6	3911,6	734	1894,6	1974,6	3789,2	3949,2					
547	1857,2	1937,2	3714,4	3874,4	641	1876,0	1956,0	3752,0	3912,0	735	1894,8	1974,8	3789,6	3949,6					
548	1857,4	1937,4	3714,8	3874,8	642	1876,2	1956,2	3752,4	3912,4	736	1895,0	1975,0	3790,0	3950,0					
549	1857,6	1937,6	3715,2	3875,2	643	1876,4	1956,4	3752,8	3912,8	737	1895,2	1975,2	3790,4	3950,4					
550	1857,8	1937,8	3715,6	3875,6	644	1876,6	1956,6	3753,2	3913,2	738	1895,4	1975,4	3790,8	3950,8					
551	1858,0	1938,0	3716,0	3876,0	645	1876,8	1956,8	3753,6	3913,6	739	1895,6	1975,6	3791,2	3951,2					
552	1858,2	1938,2	3716,4	3876,4	646	1877,0	1957,0	3754,0	3914,0	740	1895,8	1975,8	3791,6	3951,6					
553	1858,4	1938,4	3716,8	3876,8	647	1877,2	1957,2	3754,4	3914,4	741	1896,0	1976,0	3792,0	3952,0					
554	1858,6	1938,6	3717,2	3877,2	648	1877,4	1957,4	3754,8	3914,8	742	1896,2	1976,2	3792,4	3952,4					
555	1858,8	1938,8	3717,6	3877,6	649	1877,6	1957,6	3755,2	3915,2	743	1896,4	1976,4	3792,8	3952,8					
556	1859,0	1939,0	3718,0	3878,0	650	1877,8	1957,8	3755,6	3915,6	744	1896,6	1976,6	3793,2	3953,2					
557	1859,2	1939,2	3718,4	3878,4	651	1878,0	1958,0	3756,0	3916,0	745	1896,8	1976,8	3793,6	3953,6					
558	1859,4	1939,4	3718,8	3878,8	652	1878,2	1958,2	3756,4	3916,4	746	1897,0	1977,0	3794,0	3954,0					
559	1859,6	1939,6	3719,2	3879,2	653	1878,4	1958,4	3756,8	3916,8	747	1897,2	1977,2	3794,4	3954,4					
560	1859,8	1939,8	3719,6	3879,6	654	1878,6	1958,6	3757,2	3917,2	748	1897,4	1977,4	3794,8	3954,8					
561	1860,0	1940,0	3720,0	3880,0	655	1878,8	1958,8	3757,6	3917,6	749	1897,6	1977,6	3795,2	3955,2					
562	1860,2	1940,2	3720,4	3880,4	656	1879,0	1959,0	3758,0	3918,0	750	1897,8	1977,8	3795,6	3955,6					
563	1860,4	1940,4	3720,8	3880,8	657	1879,2	1959,2	3758,4	3918,4	751	1898,0	1978,0	3796,0	3956,0					
564	1860,6	1940,6	3721,2	3881,2	658	1879,4	1959,4	3758,8	3918,8	752	1898,2	1978,2	3796,4	3956,4					
565	1860,8	1940,8	3721,6	3881,6	659	1879,6	1959,6	3759,2	3919,2	753	1898,4	1978,4	3796,8	3956,8					
566	1861,0	1941,0	3722,0	3882,0	660	1879,8	1959,8	3759,6	3919,6	754	1898,6	1978,6	3797,2	3957,2					
567	1861,2	1941,2	3722,4	3882,4	661	1880,0	1960,0	3760,0	3920,0	755	1898,8	1978,8	3797,6	3957,6					
568	1861,4	1941,4	3722,8	3882,8	662	1880,2	1960,2	3760,4	3920,4	756	1899,0	1979,0	3798,0	3958,0					
569	1861,6	1941,6	3723,2	3883,2	663	1880,4	1960,4	3760,8	3920,8	757	1899,2	1979,2	3798,4	3958,4					
570	1861,8	1941,8	3723,6	3883,6	664	1880,6	1960,6	3761,2	3921,2	758	1899,4	1979,4	3798,8	3958,8					
571	1862,0	1942,0	3724,0	3884,0	665	1880,8	1960,8	3761,6	3921,6	759	1899,6	1979,6	3799,2	3959,2					
572	1862,2	1942,2	3724,4	3884,4	666	1881,0	1961,0	3762,0	3922,0	760	1899,8	1979,8	3799,6	3959,6					
573	1862,4	1942,4	3724,8	3884,8	667	1881,2	1961,2	3762,4	3922,4	761	1900,0	1980,0	3800,0	3960,0					
574	1862,6	1942,6	3725,2	3885,2	668	1881,4	1961,4	3762,8	3922,8	762	1900,2	1980,2	3800,4	3960,4					
575	1862,8	1942,8	3725,6	3885,6	669	1881,6	1961,6	3763,2	3923,2	763	1900,4	1980,4	3800,8	3960,8					
576	1863,0	1943,0	3726,0	3886,0	670	1881,8	1961,8	3763,6	3923,6	764	1900,6	1980,6	3801,2	3961,2					
577	1863,2	1943,2	3726,4	3886,4	671	1882,0	1962,0	3764,0	3924,0	765	1900,8	1980,8	3801,6	3961,6					
578	1863,4	1943,4	3726,8	3886,8	672	1882,2	1962,2	3764,4	3924,4	766	1901,0	1981,0	3802,0	3962,0					
579	1863,6	1943,6	3727,2	3887,2	673	1882,4	1962,4	3764,8	3924,8	767	1901,2	1981,2	3802,4	3962,4					
580	1863,8	1943,8	3727,6	3887,6	674	1882,6	1962,6	3765,2	3925,2	768	1901,4	1981,4	3802,8	3962,8					
581	1864,0	1944,0	3728,0	3888,0	675	1882,8	1962,8	3765,6	3925,6	769	1901,6	1981,6	3803,2	3963,2					
582	1864,2	1944,2	3728,4	3888,4	676	1883,0	1963,0	3766,0	3926,0	770	1901,8	1981,8	3803,6	3963,6					
583	1864,4	1944,4	3728,8	3888,8	677	1883,2	1963,2	3766,4	3926,4	771	1902,0	1982,0	3804,0	3964,0					
584	1864,6	1944,6	3729,2	3889,2	678	1883,4	1963,4	3766,8	3926,8	772	1902,2	1982,2	3804,4	3964,4					
585	1864,8	1944,8	3729,6	3889,6	679	1883,6	1963,6	3767,2	3927,2	773	1902,4	1982,4	3804,8	3964,8					
586	1865,0	1945,0	3730,0	3890,0	680	1883,8	1963,8	3767,6	3927,6	774	1902,6	1982,6	3805,2	3965,2					
587	1865,2	1945,2	3730,4	3890,4	681	1884,0	1964,0	3768,0	3928,0	775	1902,8	1982,8	3805,6	3965,6					
588	1865,4	1945,4	3730,8	3890,8	682	1884,2	1964,2	3768,4	3928,4	776	1903,0	1983,0	3806,0	3966,0					
589	1865,6	1945,6	3731,2	3891,2	683	1884,4	1964,4	3768,8	3928,8	777	1903,2	1983,2	3806,4	3966,4					
590	1865,8	1945,8	3731,6	3891,6	684	1884,6	1964,6	3769,2	3929,2	778	1903,4	1983,4	3806,8	3966,8					
591	1866,0	1946,0	3732,0	3892,0	685	1884,8	1964,8	3769,6	3929,6	779	1903,6	1983,6	3807,2	3967,2					
592	1866,2	1946,2	3732,4	3892,4	686	1885,0	1965,0	3770,0	3930,0	780	1903,8	1983,8	3807,6	3967,6					
593	1866,4	1946,4	3732,8	3892,8	687	1885,2	1965,2	3770,4	3930,4	781	1904,0	1984,0	3808,0	3968,0					
594	1866,6	1946,6	3733,2	3893,2	688	1885,4	1965,4	3770,8	3930,8	782	1904,2	1984,2	3808,4	3968,4					
595	1866,8	1946,8	3733,6	3893,6	689	1885,6	1965,6	3771,2	3931,2	783	1904,4	1984,4	3808,8	3968,8					
596	1867,0	1947,0	3734,0	3894,0	690	1885,8	1965,8	3771,6	3931,6	784	1904,6	1984,6	3809,2	3969,2					
597	1867,2	1947,2	3734,4	3894,4	691	1886,0	1966,0	3772,0	3932,0	785	1904,8	1984,8	3809,6	3969,6					
598	1867,4	1947,4	3734,8	3894,8	692	1886,2	1966,2	3772,4	3932,4	786	1905,0	1985,0	3810,0	3970,0					
599	1867,6	1947,6	3735,2	3895,2	693	1886,4	1966,4	3772,8	3932,8	787	1905,2	1985,2	3810,4	3970,4					
600	1867,8	1947,8	3735,6	3895,6	694	1886,6	1966,6	3773,2	3933,2	788	1905,4	1985,4	3810,8	3970,8					
601	1868,0	1948,0	3736,0	3896,0	695	1886,8	1966,8	3773,6	3933,6	789	1905,6	1985,6	3811,2	3971,2					
602	1868,2	1948,2	3736,4	3896,4	696	1887,0	1967,0	3774,0	3934,0	790	1905,8	1985,8	3811,6	3971,6					
603	1868,4	1948,4	3736,8	3896,8	697	1887,2	1967,2	3774,4	3934,4	791	1906,0	1986,0	3812,0	3972,0					
604	1868,6	1948,6	3737,2	3897,2	698	1887,4	1967,4	3774,8	3934,8	792	1906,2	1986,2	3812,4	3972,4					
605	1868,8	1948,8	3737,6	3897,6	699	1887,6	1967,6	3775,2	3935,2	793	1906,4	1986,4	3812,8	3972,8					

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WCDMA Rx frequencies

Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX
10562	2112.4	4224.8	10625	2125	4250	10688	2137.6	4275.2	10751	2150.2	4300.4	10814	2162.8	4325.6
10563	2112.6	4225.2	10626	2125.2	4250.4	10689	2137.8	4275.6	10752	2150.4	4300.8	10815	2163	4326
10564	2112.8	4225.6	10627	2125.4	4250.8	10690	2138	4276	10753	2150.6	4301.2	10816	2163.2	4326.4
10565	2113	4226	10628	2125.6	4251.2	10691	2138.2	4276.4	10754	2150.8	4301.6	10817	2163.4	4326.8
10566	2113.2	4226.4	10629	2125.8	4251.6	10692	2138.4	4276.8	10755	2151	4302	10818	2163.6	4327.2
10567	2113.4	4226.8	10630	2126	4252	10693	2138.6	4277.2	10756	2151.2	4302.4	10819	2163.8	4327.6
10568	2113.6	4227.2	10631	2126.2	4252.4	10694	2138.8	4277.6	10757	2151.4	4302.8	10820	2164	4328
10569	2113.8	4227.6	10632	2126.4	4252.8	10695	2139	4278	10758	2151.6	4303.2	10821	2164.2	4328.4
10570	2114	4228	10633	2126.6	4253.2	10696	2139.2	4278.4	10759	2151.8	4303.6	10822	2164.4	4328.8
10571	2114.2	4228.4	10634	2126.8	4253.6	10697	2139.4	4278.8	10760	2152	4304	10823	2164.6	4329.2
10572	2114.4	4228.8	10635	2127	4254	10698	2139.6	4279.2	10761	2152.2	4304.4	10824	2164.8	4329.6
10573	2114.6	4229.2	10636	2127.2	4254.4	10699	2139.8	4279.6	10762	2152.4	4304.8	10825	2165	4330
10574	2114.8	4229.6	10637	2127.4	4254.8	10700	2140	4280	10763	2152.6	4305.2	10826	2165.2	4330.4
10575	2115	4230	10638	2127.6	4255.2	10701	2140.2	4280.4	10764	2152.8	4305.6	10827	2165.4	4330.8
10576	2115.2	4230.4	10639	2127.8	4255.6	10702	2140.4	4280.8	10765	2153	4306	10828	2165.6	4331.2
10577	2115.4	4230.8	10640	2128	4256	10703	2140.6	4281.2	10766	2153.2	4306.4	10829	2165.8	4331.6
10578	2115.6	4231.2	10641	2128.2	4256.4	10704	2140.8	4281.6	10767	2153.4	4306.8	10830	2166	4332
10579	2115.8	4231.6	10642	2128.4	4256.8	10705	2141	4282	10768	2153.6	4307.2	10831	2166.2	4332.4
10580	2116	4232	10643	2128.6	4257.2	10706	2141.2	4282.4	10769	2153.8	4307.6	10832	2166.4	4332.8
10581	2116.2	4232.4	10644	2128.8	4257.6	10707	2141.4	4282.8	10770	2154	4308	10833	2166.6	4333.2
10582	2116.4	4232.8	10645	2129	4258	10708	2141.6	4283.2	10771	2154.2	4308.4	10834	2166.8	4333.6
10583	2116.6	4233.2	10646	2129.2	4258.4	10709	2141.8	4283.6	10772	2154.4	4308.8	10835	2167	4334
10584	2116.8	4233.6	10647	2129.4	4258.8	10710	2142	4284	10773	2154.6	4309.2	10836	2167.2	4334.4
10585	2117	4234	10648	2129.6	4259.2	10711	2142.2	4284.4	10774	2154.8	4309.6	10837	2167.4	4334.8
10586	2117.2	4234.4	10649	2129.8	4259.6	10712	2142.4	4284.8	10775	2155	4310	10838	2167.6	4335.2
10587	2117.4	4234.8	10650	2130	4260	10713	2142.6	4285.2	10776	2155.2	4310.4			
10588	2117.6	4235.2	10651	2130.2	4260.4	10714	2142.8	4285.6	10777	2155.4	4310.8			
10589	2117.8	4235.6	10652	2130.4	4260.8	10715	2143	4286	10778	2155.6	4311.2			
10590	2118	4236	10653	2130.6	4261.2	10716	2143.2	4286.4	10779	2155.8	4311.6			
10591	2118.2	4236.4	10654	2130.8	4261.6	10717	2143.4	4286.8	10780	2156	4312			
10592	2118.4	4236.8	10655	2131	4262	10718	2143.6	4287.2	10781	2156.2	4312.4			
10593	2118.6	4237.2	10656	2131.2	4262.4	10719	2143.8	4287.6	10782	2156.4	4312.8			
10594	2118.8	4237.6	10657	2131.4	4262.8	10720	2144	4288	10783	2156.6	4313.2			
10595	2119	4238	10658	2131.6	4263.2	10721	2144.2	4288.4	10784	2156.8	4313.6			
10596	2119.2	4238.4	10659	2131.8	4263.6	10722	2144.4	4288.8	10785	2157	4314			
10597	2119.4	4238.8	10660	2132	4264	10723	2144.6	4289.2	10786	2157.2	4314.4			
10598	2119.6	4239.2	10661	2132.2	4264.4	10724	2144.8	4289.6	10787	2157.4	4314.8			
10599	2119.8	4239.6	10662	2132.4	4264.8	10725	2145	4290	10788	2157.6	4315.2			
10600	2120	4240	10663	2132.6	4265.2	10726	2145.2	4290.4	10789	2157.8	4315.6			
10601	2120.2	4240.4	10664	2132.8	4265.6	10727	2145.4	4290.8	10790	2158	4316			
10602	2120.4	4240.8	10665	2133	4266	10728	2145.6	4291.2	10791	2158.2	4316.4			
10603	2120.6	4241.2	10666	2133.2	4266.4	10729	2145.8	4291.6	10792	2158.4	4316.8			
10604	2120.8	4241.6	10667	2133.4	4266.8	10730	2146	4292	10793	2158.6	4317.2			
10605	2121	4242	10668	2133.6	4267.2	10731	2146.2	4292.4	10794	2158.8	4317.6			
10606	2121.2	4242.4	10669	2133.8	4267.6	10732	2146.4	4292.8	10795	2159	4318			
10607	2121.4	4242.8	10670	2134	4268	10733	2146.6	4293.2	10796	2159.2	4318.4			
10608	2121.6	4243.2	10671	2134.2	4268.4	10734	2146.8	4293.6	10797	2159.4	4318.8			
10609	2121.8	4243.6	10672	2134.4	4268.8	10735	2147	4294	10798	2159.6	4319.2			
10610	2122	4244	10673	2134.6	4269.2	10736	2147.2	4294.4	10799	2159.8	4319.6			
10611	2122.2	4244.4	10674	2134.8	4269.6	10737	2147.4	4294.8	10800	2160	4320			
10612	2122.4	4244.8	10675	2135	4270	10738	2147.6	4295.2	10801	2160.2	4320.4			
10613	2122.6	4245.2	10676	2135.2	4270.4	10739	2147.8	4295.6	10802	2160.4	4320.8			
10614	2122.8	4245.6	10677	2135.4	4270.8	10740	2148	4296	10803	2160.6	4321.2			
10615	2123	4246	10678	2135.6	4271.2	10741	2148.2	4296.4	10804	2160.8	4321.6			
10616	2123.2	4246.4	10679	2135.8	4271.6	10742	2148.4	4296.8	10805	2161	4322			
10617	2123.4	4246.8	10680	2136	4272	10743	2148.6	4297.2	10806	2161.2	4322.4			
10618	2123.6	4247.2	10681	2136.2	4272.4	10744	2148.8	4297.6	10807	2161.4	4322.8			
10619	2123.8	4247.6	10682	2136.4	4272.8	10745	2149	4298	10808	2161.6	4323.2			
10620	2124	4248	10683	2136.6	4273.2	10746	2149.2	4298.4	10809	2161.8	4323.6			
10621	2124.2	4248.4	10684	2136.8	4273.6	10747	2149.4	4298.8	10810	2162	4324			
10622	2124.4	4248.8	10685	2137	4274	10748	2149.6	4299.2	10811	2162.2	4324.4			
10623	2124.6	4249.2	10686	2137.2	4274.4	10749	2149.8	4299.6	10812	2162.4	4324.8			
10624	2124.8	4249.6	10687	2137.4	4274.8	10750	2150	4300	10813	2162.6	4325.2			

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WCDMA Tx frequencies

Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX
9612	1922.4	3844.8	9671	1934.2	3868.4	9730	1946	3892	9789	1957.8	3915.6	9848	1969.6	3939.2
9613	1922.6	3845.2	9672	1934.4	3868.8	9731	1946.2	3892.4	9790	1958	3916	9849	1969.8	3939.6
9614	1922.8	3845.6	9673	1934.6	3869.2	9732	1946.4	3892.8	9791	1958.2	3916.4	9850	1970	3940
9615	1923	3846	9674	1934.8	3869.6	9733	1946.6	3893.2	9792	1958.4	3916.8	9851	1970.2	3940.4
9616	1923.2	3846.4	9675	1935	3870	9734	1946.8	3893.6	9793	1958.6	3917.2	9852	1970.4	3940.8
9617	1923.4	3846.8	9676	1935.2	3870.4	9735	1947	3894	9794	1958.8	3917.6	9853	1970.6	3941.2
9618	1923.6	3847.2	9677	1935.4	3870.8	9736	1947.2	3894.4	9795	1959	3918	9854	1970.8	3941.6
9619	1923.8	3847.6	9678	1935.6	3871.2	9737	1947.4	3894.8	9796	1959.2	3918.4	9855	1971	3942
9620	1924	3848	9679	1935.8	3871.6	9738	1947.6	3895.2	9797	1959.4	3918.8	9856	1971.2	3942.4
9621	1924.2	3848.4	9680	1936	3872	9739	1947.8	3895.6	9798	1959.6	3919.2	9857	1971.4	3942.8
9622	1924.4	3848.8	9681	1936.2	3872.4	9740	1948	3896	9799	1959.8	3919.6	9858	1971.6	3943.2
9623	1924.6	3849.2	9682	1936.4	3872.8	9741	1948.2	3896.4	9800	1960	3920	9859	1971.8	3943.6
9624	1924.8	3849.6	9683	1936.6	3873.2	9742	1948.4	3896.8	9801	1960.2	3920.4	9860	1972	3944
9625	1925	3850	9684	1936.8	3873.6	9743	1948.6	3897.2	9802	1960.4	3920.8	9861	1972.2	3944.4
9626	1925.2	3850.4	9685	1937	3874	9744	1948.8	3897.6	9803	1960.6	3921.2	9862	1972.4	3944.8
9627	1925.4	3850.8	9686	1937.2	3874.4	9745	1949	3898	9804	1960.8	3921.6	9863	1972.6	3945.2
9628	1925.6	3851.2	9687	1937.4	3874.8	9746	1949.2	3898.4	9805	1961	3922	9864	1972.8	3945.6
9629	1925.8	3851.6	9688	1937.6	3875.2	9747	1949.4	3898.8	9806	1961.2	3922.4	9865	1973	3946
9630	1926	3852	9689	1937.8	3875.6	9748	1949.6	3899.2	9807	1961.4	3922.8	9866	1973.2	3946.4
9631	1926.2	3852.4	9690	1938	3876	9749	1949.8	3899.6	9808	1961.6	3923.2	9867	1973.4	3946.8
9632	1926.4	3852.8	9691	1938.2	3876.4	9750	1950	3900	9809	1961.8	3923.6	9868	1973.6	3947.2
9633	1926.6	3853.2	9692	1938.4	3876.8	9751	1950.2	3900.4	9810	1962	3924	9869	1973.8	3947.6
9634	1926.8	3853.6	9693	1938.6	3877.2	9752	1950.4	3900.8	9811	1962.2	3924.4	9870	1974	3948
9635	1927	3854	9694	1938.8	3877.6	9753	1950.6	3901.2	9812	1962.4	3924.8	9871	1974.2	3948.4
9636	1927.2	3854.4	9695	1939	3878	9754	1950.8	3901.6	9813	1962.6	3925.2	9872	1974.4	3948.8
9637	1927.4	3854.8	9696	1939.2	3878.4	9755	1951	3902	9814	1962.8	3925.6	9873	1974.6	3949.2
9638	1927.6	3855.2	9697	1939.4	3878.8	9756	1951.2	3902.4	9815	1963	3926	9874	1974.8	3949.6
9639	1927.8	3855.6	9698	1939.6	3879.2	9757	1951.4	3902.8	9816	1963.2	3926.4	9875	1975	3950
9640	1928	3856	9699	1939.8	3879.6	9758	1951.6	3903.2	9817	1963.4	3926.8	9876	1975.2	3950.4
9641	1928.2	3856.4	9700	1940	3880	9759	1951.8	3903.6	9818	1963.6	3927.2	9877	1975.4	3950.8
9642	1928.4	3856.8	9701	1940.2	3880.4	9760	1952	3904	9819	1963.8	3927.6	9878	1975.6	3951.2
9643	1928.6	3857.2	9702	1940.4	3880.8	9761	1952.2	3904.4	9820	1964	3928	9879	1975.8	3951.6
9644	1928.8	3857.6	9703	1940.6	3881.2	9762	1952.4	3904.8	9821	1964.2	3928.4	9880	1976	3952
9645	1929	3858	9704	1940.8	3881.6	9763	1952.6	3905.2	9822	1964.4	3928.8	9881	1976.2	3952.4
9646	1929.2	3858.4	9705	1941	3882	9764	1952.8	3905.6	9823	1964.6	3929.2	9882	1976.4	3952.8
9647	1929.4	3858.8	9706	1941.2	3882.4	9765	1953	3906	9824	1964.8	3929.6	9883	1976.6	3953.2
9648	1929.6	3859.2	9707	1941.4	3882.8	9766	1953.2	3906.4	9825	1965	3930	9884	1976.8	3953.6
9649	1929.8	3859.6	9708	1941.6	3883.2	9767	1953.4	3906.8	9826	1965.2	3930.4	9885	1977	3954
9650	1930	3860	9709	1941.8	3883.6	9768	1953.6	3907.2	9827	1965.4	3930.8	9886	1977.2	3954.4
9651	1930.2	3860.4	9710	1942	3884	9769	1953.8	3907.6	9828	1965.6	3931.2	9887	1977.4	3954.8
9652	1930.4	3860.8	9711	1942.2	3884.4	9770	1954	3908	9829	1965.8	3931.6	9888	1977.6	3955.2
9653	1930.6	3861.2	9712	1942.4	3884.8	9771	1954.2	3908.4	9830	1966	3932			
9654	1930.8	3861.6	9713	1942.6	3885.2	9772	1954.4	3908.8	9831	1966.2	3932.4			
9655	1931	3862	9714	1942.8	3885.6	9773	1954.6	3909.2	9832	1966.4	3932.8			
9656	1931.2	3862.4	9715	1943	3886	9774	1954.8	3909.6	9833	1966.6	3933.2			
9657	1931.4	3862.8	9716	1943.2	3886.4	9775	1955	3910	9834	1966.8	3933.6			
9658	1931.6	3863.2	9717	1943.4	3886.8	9776	1955.2	3910.4	9835	1967	3934			
9659	1931.8	3863.6	9718	1943.6	3887.2	9777	1955.4	3910.8	9836	1967.2	3934.4			
9660	1932	3864	9719	1943.8	3887.6	9778	1955.6	3911.2	9837	1967.4	3934.8			
9661	1932.2	3864.4	9720	1944	3888	9779	1955.8	3911.6	9838	1967.6	3935.2			
9662	1932.4	3864.8	9721	1944.2	3888.4	9780	1956	3912	9839	1967.8	3935.6			
9663	1932.6	3865.2	9722	1944.4	3888.8	9781	1956.2	3912.4	9840	1968	3936			
9664	1932.8	3865.6	9723	1944.6	3889.2	9782	1956.4	3912.8	9841	1968.2	3936.4			
9665	1933	3866	9724	1944.8	3889.6	9783	1956.6	3913.2	9842	1968.4	3936.8			
9666	1933.2	3866.4	9725	1945	3890	9784	1956.8	3913.6	9843	1968.6	3937.2			
9667	1933.4	3866.8	9726	1945.2	3890.4	9785	1957	3914	9844	1968.8	3937.6			
9668	1933.6	3867.2	9727	1945.4	3890.8	9786	1957.2	3914.4	9845	1969	3938			
9669	1933.8	3867.6	9728	1945.6	3891.2	9787	1957.4	3914.8	9846	1969.2	3938.4			
9670	1934	3868	9729	1945.8	3891.6	9788	1957.6	3915.2	9847	1969.4	3938.8			

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